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Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.


THE SHIP CANAL connecting Lake Union and Lake Washington with Puget Sound, for the survey of which the last Congress appropriated $10,000, will be about 5 miles long. Less than 2 miles of this distance will be through upland, the remainder being through the tide-water flats. The maximum cut will not exceed 40 ft., and there is practically no rock work. The elevation to be overcome by locks is only 10 ft.

THE RECLAMATION OF THE OKEFENOKEE SWAMP, in Georgia, by means of drainage canals running to the St. Mary's River, is proposed. The area of the swamp is 676 sq. m. There will be about 64 miles of main and 1,300 miles of lateral canals and many small agricultural drains. From the swamp to tide-water on the river there is a fall of 125 ft. in 7 miles, and a valuable water-power will be created and made available. Some of the canalization will consist of clearing and deepening streams. The water in the swamp is from 1 to 2 ft. deep, and in holes 5 to 6 ft. A large amount of valuable cypress, cedar and red bay timber can be obtained within the proposed area of reclamation, and the land will probably prove as fertile and adapted to sugar-cane, rice and tobacco culture as similar areas in Florida. The project is based on surveys made by Gen. GILLMORE in 1879 and Mr. KRAEMER in 1890. The promoter of the enterprise is the Suwanee Canal Co., whose Consulting Engineer, Mr. J. F. LEBARON, is at present engaged in laying out the proposed work.

RAPID MAIL DELIVERY BY STREET CARS is proposed by the Post Office authorities in Buffalo, N. Y. Each car is to carry a box into which the letters can be slipped, and from which they are removed at a central station, to which all the lines in the city run. The Buffalo Ry. Co., which operates the railways, is in favor of the plan.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a freight train collision on the New York, West Shore & Buffalo R. R., at Marlborough, N. Y., May 2. The engine of a southbound train had been detached to pick up cars and do some switching. A northbound passenger train passed, with signals that a second section was following, but these were disregarded by the crew of the freight train, and when the light engine, which was running as the second section came up, the brakeman opened the witch, thinking it was the freight engine. The engine and 2 or 3 freight cars were wrecked, and one of the latter was burned. Two men were seriously injured. The accident was apparently due to an unprotected switch, and to carelessness on the part of the trainmen. A serious rear collision occurred on the Wheeling & Lake Erie R. R., near Norwalk, O., May 1. A fast passenger train ran into a train of empty coal cars, wrecking the caboose and 5 cars, and damaging the engine. Two men were injured. The accident occurred near a large trestle. A New York, Providence & Boston R. R. train was derailed at a switch at Providence, R. I., April 29, but no great damage was done, and nobody was injured. The switch is said to have been properly set, but some defect caused the engine to jump the rails.

BRIDGE ACCIDENTS are reported as follows: On April 30 the covered bridge over the Mattabesett River at East Berlin, Conn., on the Berlin branch of the New York, New Haven & Hartford R. R., was destroyed by fire. The bridge was about 75 ft. long. On April 29, about 175 ft. of the trestle of the Valley Ry. at Sandyville, O., was burned, having been set on fire by sparks or cinders from an engine. On April 30 a wooden highway bridge at Oxford, Pa., gave way under a traction engine.

TWO LOCOMOTIVE BOILER EXPLOSIONS are reported: The boiler of a freight engine on the Rome, Watertown & Ogdensburg R. R. exploded April 29, while the engine was switching a caboose from the main track. The engine driver was killed, his body being hurled to a considerable distance, and the fireman was badly scalded. On April 30, the boiler of a freight engine on the Dayton & Michigan R. R. exploded while the engine was hauling a train near Dayton, O. One man was killed and 2 were severely injured.

A COUPLING ROD of a passenger engine on the Cincinnati, Hamilton & Dayton R. R. broke May 2 while the engine was hauling a train near Carlisle, O. That side of the engine was badly damaged and one side of the cab was smashed, but the train was quietly stopped. Nobody was injured.

THE SUBMARINE TUNNEL PROJECT for connecting Prince Edward's Island and New Brunswick has been examined by Sir DOUGLAS FOX, and pronounced feasible. He is now making estimates of the cost which will be forwarded to the Canadian Government when completed.

A REMARKABLE DEED has been found in Cincinnati, which is stated in a local newspaper to read as follows: "The 1-1,000 pt. of an inch from the n. e. cor. of lot No. 23, and running south ¼ of an in.; thence w. to the back line of said lot; thence n. ¼ of an inch; thence e. to pt. of beginning." This extensive tract is said to have been bought by G. W. JONES for $2.25.

A FLOATING DRY DOCK is being built on Puget Sound by Mr. R. W. DELION, of Seattle, Wash. It will be of wood, 100 × 325 ft. outside measure, and have an actual displacement of 7,000 tons loaded, and 3,200 tons empty. The dock is to be located at the city that first offers a bonus of $45,000.

THE DEEP WELL AT WHEELING, W. VA., described on page 335 of our issue of April 18, is to be continued to the depth of one mile and possibly farther. The well is now the third deepest in the United States. It has been sunk to a depth of 4,108 feet, and is said to be the only well which has ever been drilled in horizontal strata to a depth approaching this without striking veins of water. For this reason it offers an unusual opportunity for investigating the temperature of the earth's crust at great depths. The U. S. Geological Survey is therefore co-operating with the Wheeling Development Co. in sinking the well deeper, and Major. POWELL has detailed Dr. WM. HALLOCK to make temperature observations as the work progresses.

A NEW STORAGE BATTERY CAR was tested May 4 on the Germantown Passenger Ry., in Philadelphia. The inventors are Messrs. J. B. ENTZ, W. A. PHILLIPS and MONTGOMERY WADDELL, of New York. The details of the motor and connections have not yet been made public, but according to press reports the cars are to be operated in the same manner as on the Beverly & Danvers St. Ry., where the motors act as dynamos on down grades and charge the storage batteries. The new car carries from 90 to 100 cells of a novel battery having copper positive and iron negative plates in a solution containing zinc and potassium. Since no lead is employed in them their weight is brought down to 20 lbs. each.

A STEAM MOTOR FOR STREET RAILWAYS has been tested in Richmond, Va., by Mr. WILLIAM SIMPKIN, its inventor. According to press reports, the compound condensing engines employed are mounted on the boiler and exhaust into a surface condenser running the whole length of the top of the cab.

A WRITING TELEGRAPH has been recently tested on the Pittsburgh and New York line of the Postal Telegraph Co., with considerable success, it is reported. Long hand script is exactly reproduced, but slight modifications of the letters are necessary, since the style or writing pen should not be lifted from the paper. Short distance writing telegraph instruments are already used in delivering base ball scores, but this is probably the first instance of a message transmitted over as long a distance as from New York to Pittsburgh.

THE UNIVERSITY OF THE CITY OF NEW YORK contemplates enlarging its scope so as to become a university in fact as well as in name. To carry out its plans, it is proposed to move from the central part of the city to a site near Morris Dock, where the Council has the refusal of a tract of about 40 acres.

A SINGLE REDUCTION ELECTRIC CAR MOTOR has been recently placed on the market by the Edison General Electric Co. There are two direct and two consequent poles, all of soft cast steel, and so arranged that 80% of the armature is surrounded. The armature is of the Gramme type, and the current is supplied through four carbon brushes.

A FAST RUN ACROSS THE CONTINENT was made last week by a special train on the Canadian Pacific Ry., carrying passengers who arrived at Vancouver on the new steamer "Empress of India" on an excursion around the world. Press reports state that the train left Vancouver at 9.40 P. M., Pacific time, April 28, and arrived at Montreal at 5.40 P. M., May 2, thus making the run of 2,906 miles in 89 hours, or 3 days and 17 hours, an average speed, including all stops, of 32.65 miles per hour. The regular express train from the Pacific coast to Montreal takes 6 days less 50 minutes to make the same run, according to the schedule.

INVESTIGATIONS OF THE KEELY MOTOR, or, more correctly, of the theories and experiments performed by JOHN W. KEELY, are being made by several professors of the University of Pennsylvania, and some tests have been made by them which are believed to prove that the force which moves Mr. KEELY's peculiar machines is neither electricity, magnetism nor compressed air. At a meeting of several professors on April 27 it was decided that the results thus far shown made it worth while to continue the observations, notwithstanding the opposition of Trustees of the University. It should be said that Mr. KEELY has ceased work on his "commercial engine" and severed his connection with the Keely Motor Co., and claims to be devoting his whole time to investigating the laws of operation of the peculiar force which he exhibits. Very careful galvanometer tests made by Prof. KŒNIG, April 25, showed that electricity or magnetism was not the propelling force, while the hypothesis that compressed air might be the moving force seemed to be excluded by rigid examinations of the apparatus—and yet it moved.

BIDS FOR AN ELEVATED RAILWAY FRANCHISE are advertised for by the city of Philadelphia. The franchise grants the right to construct a double-track elevated railway from the Market St. Ferry along Market St., Juniper St., South Penn Square, Broad St. and Market St. to Sixty-third St. All builders are required to furnish guaranteed securities to the amount of $2,575,000 to provide for all damages to the city and property owners, the faithful performance of the work, and for the payment of dividends at an accepted rate per cent. upon gross receipts. The contract is to be executed within 30 days from the acceptance of bids. Bids will be received until June 16 by the mayor, EDWIN S. STUART. All the necessary plans, specifications and other information can be obtained at the Department of Public Works.

## Notes on English Railways.

(*Continued from p. 422.*)

MIDLAND RAILWAY.

This is one of the leading trunk-line systems and also one of the most progressive of English railways. It has instituted several important improvements in railway matters, and has more "snap" and activity about its management than some systems. Its character is shown in its neat and well-kept track, its well-built and powerful engines, and the long passenger cars carried on trucks of American pattern, which it introduced about 15 years ago. The road has some sections with unfavorable grades, but some very fast running is done with the through trains. There is an enormous coal traffic, and this traffic is so important that in 1890 the express service was cut down very considerably in order to facilitate the handling of the coal trains. Extensive works are in progress to enable the passenger and coal traffic to be handled without interfering with one another. The main line is from London to Carlisle, on the northern boundary, where connection is made with the Scotch lines. Another very important line is that from Bristol, in the west of England, via Gloucester and Birmingham, to Derby, on the main line, a distance of 132½ miles. Among the principal places on the system, with their distances from London, are the following: Leicester, 99 miles; Nottingham, 124 miles; Derby, 129 miles; Leeds, 204 miles; York; Manchester, 202 miles; Liverpool, 220 miles, and Carlisle, 310 miles. The total length of the system is 1,300 miles.

*Track.*—The track is of the standard English type, laid with bull head steel rails, weighing 85 lbs. per yd. The ballast is of broken stone, sometimes with a top course or "boxing" of gravel, fine stone or cinders. It is generally level with the tops of the ties, and on some divisions there is a longitudinal drain between the rails, the bottom being a few inches below the bottom of the ties. In some places the cinder ballast is filled in over the ends of the ties to the outer edge of the rail head. In gravel ballast there is a transverse drain about every 10 ft. On some bridges the chairs are secured to longitudinal timbers and no ballast is used; in other cases the ordinary track with cross ties and ballast is carried across the bridge. The rail ends look in good condition, and in riding over the track there is only a regular clicking at the joints, and not the harsh battering observed on some other lines. The track is kept in excellent condition, clean and neat, with the ballast even and nicely sloped. A very interesting method of carrying the rails across short bridges, station subways, etc., is shown in Fig. 47. There is a heavy longitudinal timber under each rail, and the rail is carried between two continuous angle bars extending the whole length of the bridge. Bolts with 1½ in. square heads pass through the angle bars and rails at intervals of about 20 ins., and at rail joints 4 of these bolts are used. The angle bars are fastened to the timbers by fangbolts passing through the flanges, some of them having the nut and some the head on top. North from London there are 4 tracks for a considerable distance. On a double-track bridge near Bedford the 4 lines of rails for passenger and freight tracks are gantleted. The signals are of the ordinary semaphore pattern, with a white and black ball or disc on the red and white sides of the blade respectively. Some old-style target signals, with black and white horizontal stripes, are still in use. The switch rods are of gaspipe, with screw couplings of the form shown in Fig. 48. The carriers and arrangement of compensating levers for switch rods are also shown. Catch points, or derailing switches, are used on steep grades, including the Lickey incline of 1 in 33 (3.3%). At some terminals hydraulic buffers are used, of a system invented by Mr. A. LANGLEY, Chief Engineer of the road. The gates of grade crossings near signal boxes are sometimes operated from the box. Mile and intermediate posts are made of old rails with a wooden head, as shown in Fig. 49. They are about 6 ft. high and have the figures in black on a white ground; the rail is painted black. Intermediate posts have the last full mile painted on the top, and the fraction on each side of the block, as shown. The hedge fences are trimmed in August, and the trimming makes them grow very thick. The clippings are left to dry, and then burned in heaps on the slopes of cuts, etc.

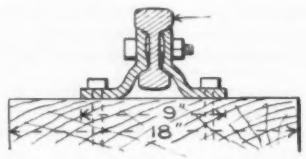



Fig. 47. Track Across Short Bridges.

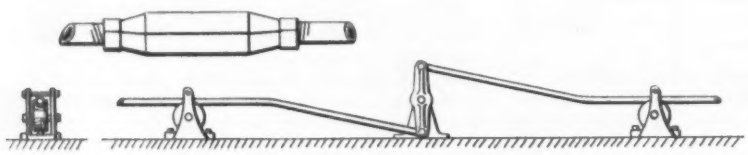


Fig. 48. Switch Rod Coupling, Carrier and Compensator.

Fig. 49. Distance Post.

TRACK DETAILS; MIDLAND RAILWAY, ENGLAND.

Near Tewkesbury is a grade crossing of two double-track lines. The Lickey incline, near Bromsgrove, on the Gloucester and Birmingham line, has a grade of 3.3%. Up trains slacken speed to allow a bank or pusher engine with 6 wheels, all coupled, to run up behind and help them over the grade. At the top of the grade is a large lamp and reflector, throwing a strong light down the track at night. Down freight trains stop at the top and have brakes applied on some of the cars. A train of 49 coal cars was seen going down. This incline was first worked with the old Norris engines built at Philadelphia, Pa. For the rebuilding of an overhead highway bridge at Mangotsfield, the rough stone for the abutments was dumped alongside the track, and the cutting to shape done by masons at the site. Gloucester has an old terminal station on what is now a through line. South-bound trains run into the station and then back out to the junction, while north-bound trains run past the station and then back into it. At Cheltenham, where cars are sometimes picked up by passenger trains, there is much delay in the operation. The car is on a side track, the switch of which is close to the end of the platform, and the incoming train is stopped with the first car nearly into the station while the engine runs ahead, backs into the sidetrack, pulls out the car and backs it onto the head of the train before the train enters the station. Some deep cuts with flat slopes have low retaining walls about 3 ft. high at the foot of the slope, and dry stone drains laid at intervals up the slope.

Near Mangotsfield and Warmley were noticed pieces of fencing made of old fishbellied rails. At Mangotsfield there is also a stretch of old unused track laid with these rails. The rails are about 15 ft. long, with 5 "bellies." They are of T-section without a bottom flange, and the web is carried between the jaws of cast-iron chairs having a base of 7¼ × 4 ins., being secured by a horizontal spike driven between the web of the rail and a groove in one of the jaws of the chair. Each chair rests on a roughly squared stone block, to which it is fastened by two spikes in ⅞-in. holes. The rails are about 2¼ ins. wide on top, with the head ⅝ in. deep; they are 2½ ins. deep at the shallow part, where they rest in the chairs, and 3½ ins. at the deepest part of the belly. The gage of this track is 5 ft. 9 ins.

*Locomotives.*—This road has a very fine locomotive equipment. For passenger service it has some large engines of the eight-wheel type, Fig. 50, but the latest type of express engine has a single pair of driving wheels, a four-wheel leading truck, and a single pair of trailing wheels. The driving wheels have outside bearings and underhung springs, as shown in Fig. 51. Engines with 4 coupled driving wheels and a single leading axle are also used in passenger service. Freight engines are of the usual type, with six wheels, all coupled. The tenders are generally large. For short distance and suburban traffic, side tank engines are extensively used. Some of these have 6 wheels, all coupled, while others (Fig. 52) have 4 coupled driving wheels under the boiler and a four-wheel truck under the rear tank and bunker. Some of these latter engines have no side tanks, but a large rear tank, as on engines of the Forney type. The boiler, wheels, splashers, frames, cabs and tanks are painted a dark bright reddish brown, almost a crimson, with black striping edged with yellow. The smokebox and smokestack are black. This brown color was adopted seven or eight years ago as a substitute for the bright emerald green formerly used. Most of the engines have an automatic (a few non-automatic) steam brake on driving and tender wheels, combined with the vacuum automatic train brake. The company's locomotive and car works are at Derby. Mr. S. W. JOHNSON is Locomotive Superintendent and Mr. T. G. CLAYTON is Car Superintendent. The following are the dimensions of the three engines illustrated:

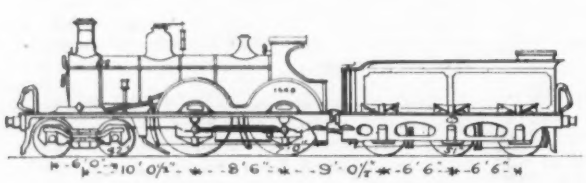


Fig. 50. Eight-Wheel Passenger Engine.

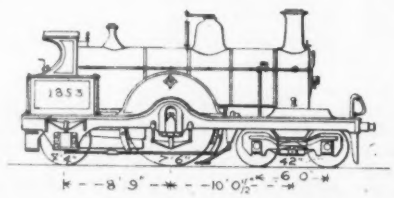



Fig. 51. Single-Driver Express Engine.

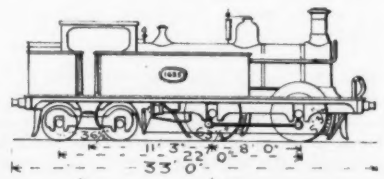


Fig. 52. Tank Engine.

LOCOMOTIVES; MIDLAND RAILWAY, ENGLAND.

| | Eight-wheel. Fig. 50. | Single-driver. Fig. 51. | Tank. Fig. 52. |
|---|---|---|---|
| Cylinders..... | 19 × 26 ins. | 18½ × 26 ins. | 17 × 24 ins. |
| Diam driving wheels..... | 7 ft. 0 in. | 7 ft 6 ins. | 5 ft. 3½ ins. |
| Diam truck wheels..... | 3 ft. 6 ins. | 3 ft. 6 ins. | 3 ft. 0½ in. |
| Diam. boiler.. | 4 ft. 3 ins. | 4 ft. 2 ins. | 4 ft. 3 ins. |
| Tubes, num.. | 205 | 244 | ..... |
| Tubes, diam.. | 1⅛ and 1¾ ins. | 1⅛ and 1⅝ ins. | ..... |
| Tubes, length. | 10 ft. 6 ins. | 10 ft. 4 ins. | 10 ft. 6 ins. |
| Heating surf.: | | | |
| Tubes, sq. ft. | 1,011 46 | 1,123.5 | 1,115 |
| Firebox, sq. ft..... | 110.16 | 117.0 | 104 |
| Total, sq. ft. | 1,121.62 | 1,240.5 | 1,219 |
| Grate area, sq. ft ..... | 17.50 | 19.6 | ..... |
| Driv. wh. base | 8 ft. 6 ins. | ..... | 8 ft. 0 in. |
| Total " " | 22 ft. 6 ins. | 21 ft. 9½ ins. | 22 ft. 0 in. |
| Weight: | | | |
| On truck, lbs | 33,276 | ..... | ..... |
| On driving wheels, lbs. | 33,684 | 39,200 | ..... |
| On trailing wheels, lbs. | 28,980 | ..... | ..... |
| Total, lbs.. | 95,900 | 98,320 | 104,300 |
| Tank, U S. gall | 3,900 | 3,900 | 1,380 |
| Coal space, lbs. | ..... | 7,840 | ..... |

*Rolling Stock.*—This road has a very good equipment for its main-line service. It was one of the first to abandon the second class of passenger accommodation, which it did several years ago, and has now only first and third class. It was also one of the first to adopt trucks or "bogies" for the running gear of its cars, and has now a very large number of long cars on four-wheel and six-wheel trucks. The plan and elevation of one of the

latest of these are shown in Fig. 53, and a general view taken from a photograph in Fig. 54. The body is 56 ft. long and 8 ft. wide, and is divided into first and third-class compartments, with seating capacity for 16 first-class and 28 third-class passengers. There is a smoking-compartment for each class, and a third-class compartment reserved for ladies. At one end is a compartment for the conductor and baggage. There are four separate lavatories, which are arranged on a plan that is used also on the London & Northwestern Ry. and some other roads, but is objectionable in many ways. They open direct from the compartment, so that their use is embarrassing, especially where ladies are among the passengers, and there is no accommodation for the smoking-compartments. With such an arrangement it is almost impossible to avoid smell and unpleasantness. A very obvious improvement in the arrangement would be to replace the diagonal partition by two parallel partitions, with doors opening into the lavatories, and retaining the doors into the compartments. This would give better privacy, a better means of excluding smell, and a separate lavatory for men and women. It would also be better to have all the compartments of each class placed together, and all connected with the lavatories. The English objection to these modifications might be that intercommunication between the compartments is not desirable; but very much better arrangements have already been introduced on the Great Northern Ry. and the London & Northwestern Ry., as described in ENGINEERING NEWS, Feb. 7, 1891, and June 21, 1890. The cars above described are carried on six-wheel trucks with 42-in. wheels, 5 ft. 9 ins. c. to c. of axles. The truck-wheel base is 11 ft. 6 ins. and the distance c. to c. of the truck pins 37 ft. Some of the cars have a monitor roof, with a single lamp hung low enough to clear the sides of the monitor. Some of these are divided into three first and four third-class compartments, or six first-class and a baggage compartment. Some cars, including some of those on the London local trains, have two lamps in each compartment. Pullman sleeping, dining and drawing-room cars are run on this road. They are carried on six-wheel trucks, with Mansell wheels and laminated springs over each axle box. They are only available for first-class passengers, and no extra charge is made for the drawing-room cars.

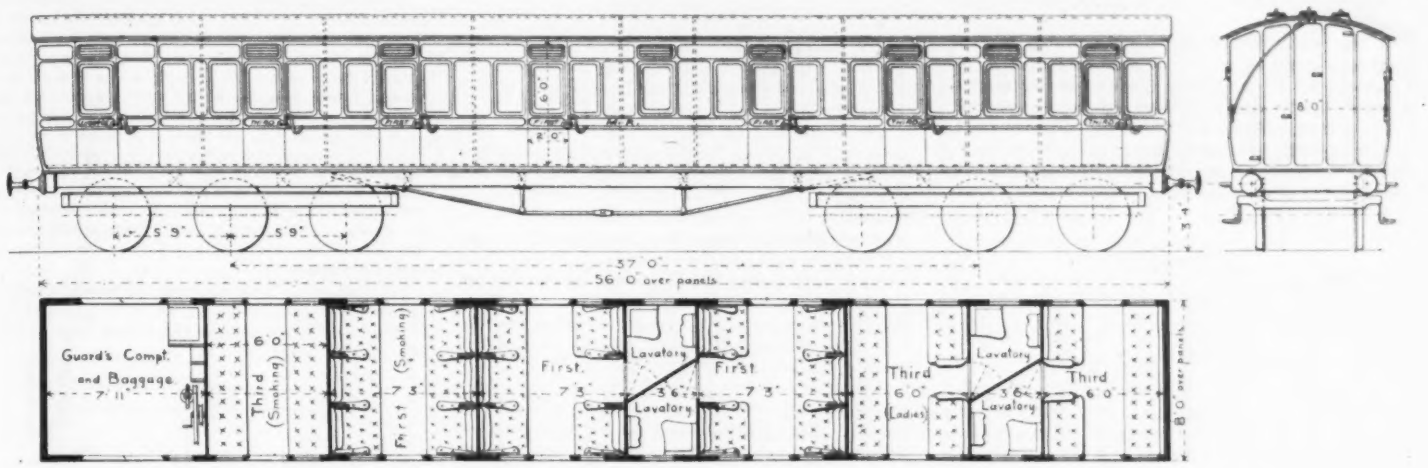



FIG. 53. ELEVATION AND PLAN OF PASSENGER CAR ON SIX-WHEEL TRUCKS, MIDLAND RAILWAY, ENGLAND.

The seats are cushioned and have high padded backs. The third-class compartments have bare floors. On the interior of this class the door and ends are painted grained yellow oak, the roof and partitions a bluish white with stenciled brown striping. The white is soon discolored and scratched by baggage in the baggage racks, and the whole effect is cheap and common, especially when contrasted with the handsome exterior. The windows are large and fitted with spring blinds of blue material, kept at any desired height by bottom rods sliding in notched guides. The doors have sliding sashes, and are fitted with spring blinds on brass guides. Gridiron ventilators are placed over the doors and in the sides of the monitor roofs, as described on page 195. There is a rack for light baggage along each partition, and against the roof are cords for holding hats by the brim. The ordinary communication cord between the cars and the engine is used, being run through rings on the eaves of the roof, but on one express train a low-sided four-wheel carriage truck was placed near the middle of the train, and the cord led down to it and up to the next car, so that it would have required a strong pull to sound the gong on the engine or in the conductors' compartment. The exterior appearance of the passenger cars is very handsome. They are painted a dark, rich crimson, with gold and black lettering and striping. Brass handles and hand rails are fitted to the doors. The Pullman cars are upholstered in dark crimson. They have the exterior painted the dark Pullman green, with a profusion of gilt tracery, filigree and paneling, in the old-fashioned style which is now nearly obsolete in this country. The appearance is by no means so attractive as that of the crimson cars. The equipment still includes a number of cars on 2 and 3 rigid axles, but the main line trains are largely made up of the long "bogie" cars. Oil boxes are generally used. The newspaper trains have four-wheel sorting cars with vestibule connections. On one occasion a lamp went out in a compartment occupied by a party of through passengers, and at the next station complaint was made, and the occupants insisted that a lamp should be provided, and refused to move to another compartment. No lamps were ready, and there was considerable confusion, but eventually a lamp was taken from an unoccupied compartment, and after long delay the train proceeded.

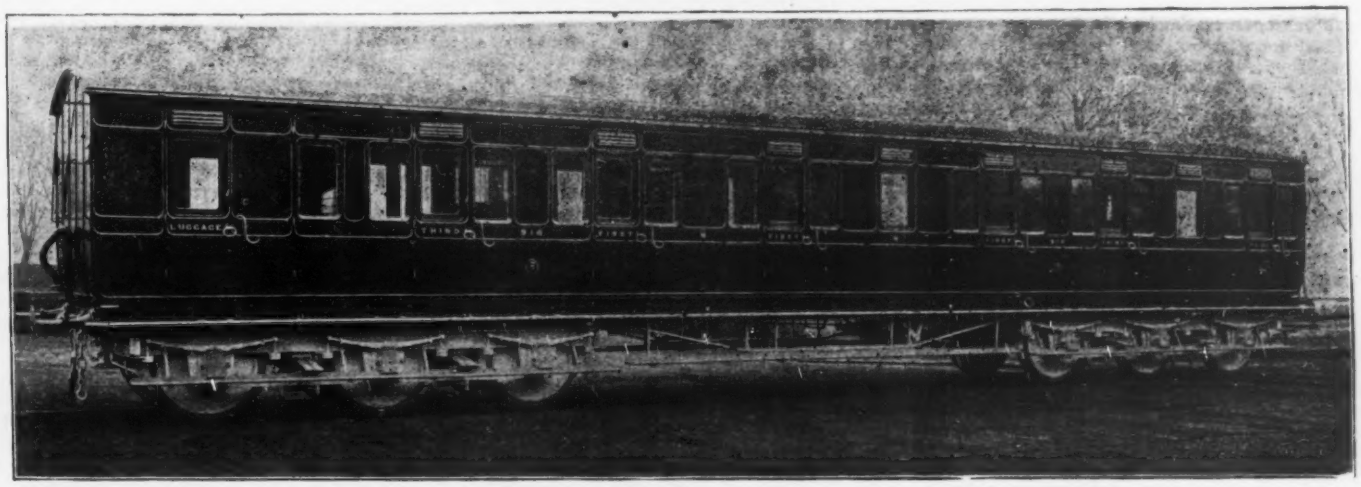



FIG. 54. PASSENGER CAR ON SIX-WHEEL TRUCKS; MIDLAND RAILWAY, ENGLAND.

The freight cars and freight-train cabooses or "brake vans" owned by the company are painted light gray, with white lettering. The cabooses are generally on 4 wheels, and some of them have a platform at each end, protected by a railing or low side with doors, and sometimes having the roof extended over them. The gravel cars of construction trains are short cars of rough construction, generally unpainted, carried on 4 spoke wheels. A leather or felt flap is placed over the axle boxes to protect them from the gravel or earth falling from the car.

E. E. R. T.

*(To be continued.)*

## The Brooklyn Water-Works Extension.

[WITH INSET.]

(*Continued from page 226.*)

II.

THE SUPPLY PONDS.

In our issue of March 7 we briefly sketched the history of the Brooklyn water-works, outlined the general plan of the present extension, and described and illustrated some details of the conduit and its accessories.

The additional supply will be drawn from five ponds, supplemented by a storage reservoir. The names of the ponds from the east or further end, west, their respective capacities, water areas and other details relating to them are given in the following table, the figures being taken from a report made before construction was started, and hence subject to modifications:

| | Capacity, galls. | Area, acres. | Depth of Excavation. Max., ft. | Depth of Excavation. Minn, ft. | Length of dam, ft. |
|---|---|---|---|---|---|
| Massapequa | 31,000,000 | 13.8 | 1.5 | 3.7 | 330 |
| Ridgewood | 23,500,000 | 16 7 | 5.6 | 6.4 | 1,250 |
| New Bridge | 16,500,000 | 9.3 | 6.7 | 7.3 | 430 |
| East Meadow | 23,500,000 | 11.8 | 6.0 | 6.9 | 525 |
| Millburn | 19,500,000 | 17.2 | 4.8 | 5.8 | 800 |
| | 114,000,000 | 68.8 | | | |

It will be seen that the excavation for each of the ponds is comparatively slight, but, with the exception of the Millburn, the ponds are all artificial and mostly in excavation. In this connection, attention is called to the fact that in the article which appeared March 7 a typographical error caused the combined capacity of the ponds to be given as 1,140,000,000 galls, instead of 114,000,000, as above.

As shown in the map in our issue of March 7, the conduit connects directly with the several ponds, with the exception of Milburn, instead of by means of branch conduits, as was the case in the original works.

The Ridgewood, New Bridge and East Meadow dams are similar in design, the brick conduit in each case changing at a gate-chamber to two lines of 48-in. cast-iron pipe, which give a sufficient depression to allow the waste-weirs to be built and discharge above the conduit. This is shown by the plan, longitudinal and cross-sections of the Ridgewood dam, on the accompanying inset. The plan and longitudinal sections, it will be understood, show but a part of the length of the embankment, the cast-iron pipe not being extended through the whole length of the dam. The details of the waste-weirs and gate-houses are shown on the inset and will be referred to further on.

The cross section of the Ridgewood dam shows the two lines of 48-in. pipe, 5⅝ ft. on centers, embedded in concrete, which practically forms a heart-wall for the dam. The concrete rests on planks 14 ft. long, and has a breadth or horizontal thickness of 13 ft. at the bottom. It tapers and is stepped to a width of 3 ft. at the top, as shown on the section.

The inner side of the dam has a slope of 2 to 1 and a 12-in. paving on 12 ins. of stone ballast. The outer slope is also 2 to 1, and both it and the top are covered with 6 ins. of soiling, all the dams being of earth.

The Massapequa and Millburn dams have a different cross-section than the other three, owing to the fact that the conduit does not pass through them, Massapequa being at the head of the conduit and Millburn being connected directly with the pumping station of the same name. A cross-section of Massapequa, which is almost identical with the Millburn section, is given on the inset. The slopes are both 2 to 1, and the inner has a 12-in. paving on 12 ins. of ballast, the latter resting, to a point slightly above high water, and 2 ft. above the natural surface, upon 2 ft. of puddle. This puddle takes a horizontal direction at the natural surface, and after extending to a point 2 ft. beyond the top of the inner slope is carried up with a thickness of 4 ft. to a point within 21 ins. of the top, thus forming a heart-wall.

As has been stated, the conduit starts at Massapequa pond. The gate-house at its head is shown in plan, section and elevation on the inset. The chamber from which the conduit starts is of masonry, 11 × 12 ft. in the clear. Water is admitted to this chamber through an arched passage, having a quarter bend to bring water into the end of the chamber, as shown by the plan and the section A B C. This passage is of brick, 4 ft. wide and 4¼ ft. high to the springing of the arch. The arch has a radius of 2⅓ ft., and a 12-in. ring. The walls of the passage are backed with rubble masonry, which, together with the bottom of the passage, the 12-in. cut paving of the chambers and the walls of the latter rest on 6 ins. of concrete, which in turn is placed upon two layers of plank, the upper 2, and the lower 3 ins. thick. The brick walls of the passage are bonded into the rubble backing. The portal of the passage is of masonry, as shown by section A B C, and the north elevation. Two 4 × 4-in. grooves are provided at the mouth of the arched way for sliding gates. The covered portion of the passage has a brick bottom 12 ins. thick, and the open portion a 12-in. cut stone paving. The arched passage enters the chamber 1.73 ft. above the bottom of the latter, which is 8 ins. below the bottom of the conduit.

The waste weir at Massapequa is simpler than those at Ridgewood, New Bridge and East Meadow, owing to the fact that the conduit does not pass through this dam. The weir is of masonry, with an overflow 17 ft. wide and 5.7 ft. deep to the top of the coping of the end walls. It is provided with a gate 3.58 ft. wide at the bottom and about 4½ ft. wide at the top, extending to the foot of the overflow wall, through which the pond can be emptied. Details of the weir will be seen by referring to the plan, sections and elevations upon the inset. The whole structure rests upon a platform composed of double 3-in. planking on 8 × 10-in. timbers. Above the planking is 6 ins. of concrete and the water way has a 9-in. paving. The platform and paving are protected both on the inner and outer sides, by planking extending from the top of the paving down into the natural earth.

The overflow wall of the weir is 6.79 ft. thick at the bottom and 4 ft. at the top, battering 1 in 6 on the inner, and 1 in 4 on the outer side. It is 6.7 ft. in height, above the paving. The top of the wall is level for 1 ft. from the inner side, then slopes 6 ins. in 3 ft. and is rounded to meet the outer slope. The wing walls are capped with 6 in. stone, 3¼ ft. wide, and are 2¾ ft. thick at the top, battering 1 in 6 on the embankment, and 1 in 12 on the inner side. Buttresses just above and below the overfall extend from the wings into the embankment, as shown by the illustrations.

The waste weirs at Ridgewood, New Bridge and East Meadow are similar in design and are shown by the details of the easterly weir at East Meadow. Connected with these weirs are chambers which serve to admit water from the ponds to the conduit and to shut off the flow in the conduit from all the ponds above. The general design will be understood by referring to the illustrations of the East Meadow weir, on the inset. It will be seen that the conduit at this point discharges into a chamber, and that the water passes from the latter into two 48-in. pipes, which are carried below the surface of the weir, as shown in detail in section E F. A lifting gate fits in the grooves shown in the plan and section and shuts off, when desired, all the water of this or the above ponds from the conduit below. Water is admitted to the chamber and conduit through the passage shown in the plan and by section C D. The supply from this pond may be shut off by gates working in the grooves shown in the sections. The pond may be entirely emptied through the drains beneath the weir shown in sections A B and E F. The drain is kept closed by a stone at its mouth which slides down the inner face of the weir, the lower edge of the stone fitting into a groove, as shown in section E F.

The overfall, as is shown by section E F, is 12.4 ft. wide on top, with a slope of 6 ins. in this distance. With the exception of a part of the space between the pipes which is filled with concrete, the wall of the overfall is of masonry. The weir above and below the overflow wall has a split stone paving. The floor of the chamber has a 9-in. cut stone paving. The whole structure rests upon a concrete and timber foundation, similar to those already described, but with concrete of different thickness, according to position, as shown by the sections.

(*To be continued.*)

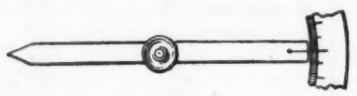
## A Suggested New Style of Compass.

From the treatise on "Surveying and Leveling Instruments," by Mr. WM. FORD STANLEY, reviewed in another column, we reproduce the accompanying cut showing "the author's plan of needle reading," as embodying a suggestion which is new to us at least, and which strikes us as meritorious. We should mention that Mr. STANLEY is a practical instrument maker of much prominence, whose art is with him more of a profession than a trade, and who has acquired a broad and intimate knowledge of both the theory and practice of the construction and use of instruments. His suggestions therefore are entitled to more than common weight.

His description of his own device, as illustrated, is as follows:

From the difficulty of reading a sharp point in bright metal against the black lines of a divided circle, the author occasionally makes the needle with one point of a broad needle sawn vertically for a short distance, so as to form a kind of *split* which is closed at the end, so that it presents to appearance a fine black line of the same character as the divisions into which it reads. With this, as shown in the cut, the reading is found to be much easier. The point is also more easily adjusted by grinding, as the end of the needle, being broad, requires less care to be taken that it is not reduced so much that it leaves the interior of the circle short where it reads into the divisions. This form of needle is not adapted to mining instruments, which have often to be read in an oblique direction.

Every engineer and surveyor of much experience in field work must have experienced the difficulty of reading a compass accurately which this device is



A Suggested New Form of Compass Needle.

designed to obviate, and seems well calculated to obviate. And for transit work especially, inaccurate readings are often a source of great vexation, though in good transit work they are always taken. This slit, as compared with a sharp point, ought to double the precision of readings, we should judge, *i.e.*, halve the probable error of observation.

There may be practical difficulties about using this needle instead of the more common form which we do not fully appreciate. We express no opinion on that point. But unless there are great practical reasons to the contrary, we should prefer this form of needle for every kind of field instrument requiring one.

We take pleasure also in repeating here, what we have said in another column, that Mr. STANLEY's work seems to us, on the whole, the most useful and instructive treatise on instruments in the language, despite the fact that the usual American types of instruments are but lightly touched on. The differences are superficial, after all; the essential nature of engineering instruments is the same the world over.

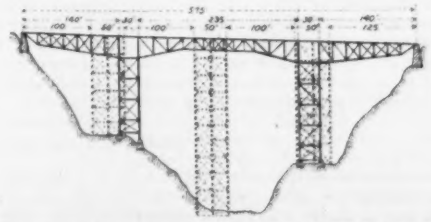
THE PRODUCTION OF PRECIOUS STONES in the United States is not extensive, to judge from the figures in a recent census bulletin. The total value of the precious stones produced in 1889 was a little over $188,800, the leading items making up this amount being: Quartz, $14,000; turquoise, $23,675; gold quartz, $9,000; agatized and jasperized wood, $53,175; zircon, $16,000. Diamond cutting is now practiced only in New York and Massachusetts.

FOREST PRESERVATION is carefully attended to in Victoria, Australia. The Minister for Mines and the Conservator of Forests recently visited the Chiltern forest for the purpose of seeing whether satisfactory arrangements could be made for saplings to be cut for mining purposes, as it had been recently found expedient to enforce a regulation preventing the cutting of trees less than 2 ft. in diameter, owing to the large quantities of young timber that were being sacrificed for fencing and firewood.

RAILWAY EXTENSIONS IN RUSSIA are said to be contemplated, amounting in all to 20,000 miles, and the matter is now under consideration by the Minister of Roads and Communications. Permission has been given for the construction of a line from Riazan to Kazan by the Moscow & Riazan Ry. Co. The line, which will be 300 miles in length, will be commenced as soon as practicable. It has also been decided to construct a line from Koorsk to Voronezh, which will be 200 miles long. All the railways planned for construction this year will be built by private companies, and not by the Government, which is sufficiently occupied with the support it is giving to the Siberian and Petrovsk railways.

## The Verrugas Viaduct.

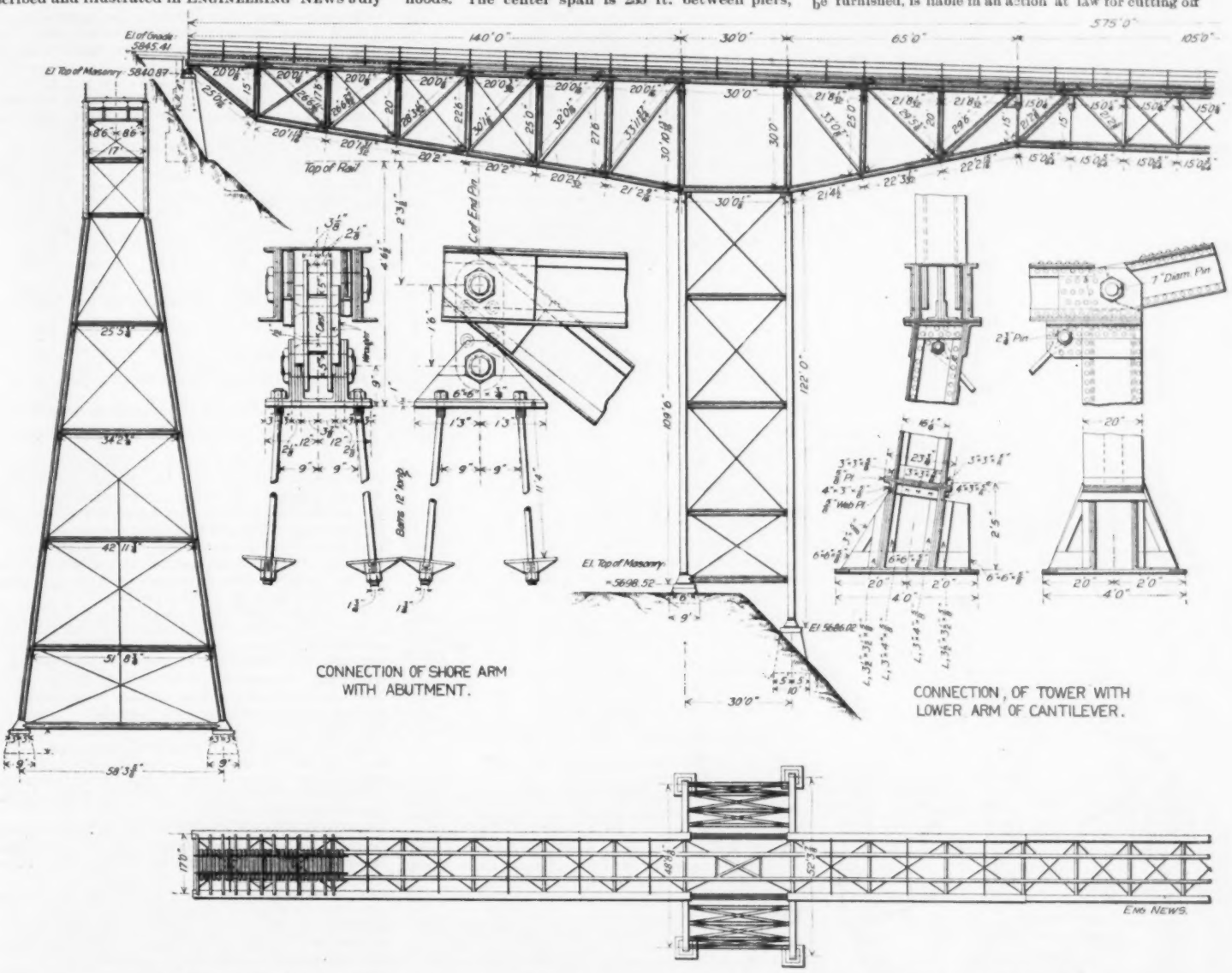
The new Verrugas viaduct, which we illustrate this week, is on the line of the Lima & Oroya Railway, in Peru, about 52 miles from Callao. It was built during the latter part of 1890, to replace the one built in 1872 to designs prepared by the late Mr. W. W. EVANS. This original viaduct, which was described and illustrated in ENGINEERING NEWS July 27, 1889, consisted of four Fink truss spans, three of 100 ft. and one of 125 ft., with a center pier 252 ft. high and two side piers 146 and 179 ft. high. Each pier was built up of 12 Phœnix columns, braced together. The center pier was 15 × 50 ft. at the top and 57 × 50 ft. at the base. It rested on a masonry foundation located at the bottom of the narrow gorge. In March, 1889, there was an exceptionally heavy rainfall which caused a torrent to flow down the gorge, undermining the masonry foundation of the center pier and causing the destruction of the middle portion of the bridge; the two side piers, end spans and abutments remaining. The smaller illustration shows a profile of the valley on the line of the viaduct, with an elevation of the new structure; the piers of the old structure being indicated by the dotted lines.



Elevation of New Verrugas Viaduct, showing by dotted lines the position of piers of old viaduct.

The new viaduct was designed by Mr. L. L. BUCK, M. Am. Soc. C. E., of New York, who was resident engineer in charge of the original structure. It is on the cantilever principle, and has but two piers, which are built on benches in the slopes of the gorge, thus leaving an unobstructed waterway for floods. The center span is 235 ft. between piers, the two side spans 140 ft. each, and the length over the piers 30 ft., making a total length of 575 ft. between end pins. The cantilevers are 30 ft. deep over the piers and 15 ft. at the ends. The panel dimensions are shown on the larger drawing. The bearings for the end pins are anchored to the masonry abutments by 4 bolts 1⅝ ins. diameter and 12 ft. long, with anchor plates at the ends. The piers consist of 4 columns braced together, and are 17 × 30 ft. at the top. The upper one is 109 ft. 6 ins. and 122 ft. high on its upper and lower sides, and the lower pier is 142 ft. 6 ins. high. The height from the lowest point of the gorge to rail level is 250 ft. The width is 17 ft. c. to c. of girders. There is a single track over the bridge, and a hand rail is fitted along each side. The viaduct has a down grade toward Lima and the coast, the elevation of track above sea level being 5,845.41 ft. at the upper end and 5,828.16 ft. at the lower end, or a grade of about 3%.

The contract for material was let in April, 1890, to the New Jersey Steel & Iron Co., of Trenton, N. J., and the size of the pieces was limited, as they had to be conveyed in small steamers and launches. The erecting and riveting was done by a bridge gang sent out from the United States, and a number of sailors were employed in handling the material. Mr. A. D. RIFFLE was Assistant Engineer for Mr. BUCK, and Mr. P. A. FRASER superintended the work as engineer for Messrs. Grace Bros., of New York, who operate the road for the bondholders, to whom it has been leased by the government. Work was commenced in July, 1890, and completed Jan. 1, 1891.




THE NEW VERRUGAS VIADUCT; LIMA & OROYA RAILWAY, PERU. Mr. L. L. Buck, M. Am. Soc. C. E., Engineer.

## Legal Decisions of Interest to Engineers.

*Liability of City for Cutting off Water Supply.*—Where a city authorized by statute to furnish water to its inhabitants to be paid for by them, and has received from a householder payment in advance for a supply of water to be furnished, is liable in an action at law for cutting off his supply, because his predecessor in title had not paid the water rent for the preceding year.—(Merrimac River Sav. Bank v. City of Lowell, Supr. Jud. Ct., Mass., 26 N. E. Rep., 97.)

*Assignment of Payments on City Contract.*—One who was indebted to a city contracted with it to repair a bridge. He completed his contract, and a portion of the compensation, with his consent was applied to his indebtedness. His surety in the contract had a warrant of attorney, authorizing him to receive all warrants which might be coming to him under his contract, and this warrant he filed with the city comptroller. He had a further agreement with the contractor by which he was to make him advances to enable him to carry on the work, and to retain the amount of such advances and compensation therefor out of the money arising from the warrants; but the city had no notice of this agreement. Without notice thereof, the city was not bound by the agreement, nor was it under any obligation to notify the surety that the contractor was its debtor, and hence such surety cannot recover from it the amount applied to the indebtedness of the former.—(Clement v. City of Phila., Supr. Ct., Pa., 20 At. Rep. 1,000.)

*Transfer of Personal Contract by Sale of Lands.*—A water-works company owned a drain and a levee connected therewith. An owner, through part of whose land the levee extended, agreed with the company that, if it would construct the levee to a certain point, he would continue it through his lands, and would maintain the part built by him and release the company from liability for damages from high-water in the past or future. The land owner's agreement to maintain his part of the levee did not run with the water-works property, and an averment that all such property of the company had been sold under a judicial decree was not sufficient to show the sale operated as an assignment of the agreement. The agreement gives the company no right to enter or repair the part of the levee built by the owner, and it cannot recover the cost of such repairs in a suit for a breach of his promise to maintain the levee. (Ind'polis W.-W. Co., v. Nultie, Supr. Ct. Ind, 26 N. E. Rep., 72.)

## Tests of the Serve Ribbed Boiler Tube.

As reported in recent issues, a test of the Serve ribbed boiler tube has recently been made at the works of Samuel L. Moore & Sons, Elizabethport, N. J., under the direction of Mr. H. B. ROELKER, M. Am. Soc. M. E.

The accompanying table gives in a condensed form the results of the test. The boiler used was an ordinary vertical tubular boiler 42 ins. in diameter. The furnace was 36 ins. in diameter and 24 ins. high, and there were 63 tubes 2¼ ins. in diameter and 6 ft. long. The total grate surface was 7 sq. ft. and the total heating surface was 287 sq. ft., of which 223 sq. ft. was in the tubes.

EVAPORATION TESTS OF A VERTICAL BOILER FITTED FIRST WITH PLAIN TUBES AND AFTERWARD WITH THE SERVE RIBBED TUBES.

| | Average draft suction. | Kind of tubes in boiler. | Date of test, April, 1891. | Ave. temp. chimney gases by pyrometer. | Ave. temp. feed water. | Lbs. feed water evaporated in 16 hours. | Average evaporation per hour, lbs. water. | Lbs. coal fired in 16 hours. | Ave. coal burned per hour, lbs. | Lbs. ashes per 100 lbs. of coal. | Lbs of combustible consumed in 16 hours.* | Lbs. water evap. Per lb. of coal fired. | Lbs. water evap. Per lb. of combustible. | Ave. lbs. of combustible burned per sq. ft. of grate per hour. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Natural draft. | ⅛ in. | plain | 6 and 7 | 68° | 190° | 8,705 | 544 | 1,716 | 107 | 9 05 | 1,340 | 5.07 | 6.50 | 10 96 |
| | ⅛ less 1/32. | ribbed | 15 and 16 | 443° | 196° | 10.275 | 642 | 1,401 | 87⅛ | 10.15 | 995 | 7.37 | 10.24 | 8.91 |
| Forced draft. | ⅛ in. | plain | 8 and 9 | 828° | 186° | 16,705 | 1,044 | 2,788 | 174 | 9.50 | 2,317 | 5.99 | 7.21 | 20.62 |
| | ⅛ in. | ribbed | 17 and 18 | 453° | 189° | 21,880 | 1,367½ | 2,881 | 180 | 10.66 | 2,285 | 7.60 | 9.58 | 20.40 |
| | ⅞ in. less 1/64 | plain | 10 and 11 | 905° | 187° | 16,650 | 1,041 | 3.557 | 222 | 19.07 | 2,918 | 4.68 | 5.70 | 26.05 |
| | ⅞ in. | ribbed | 20 and 21 | 510° | 189° | 24,380 | 1,524 | 3,609 | 225 | 10.97 | 2,912 | 6.75 | 8.37 | 25.99 |
| | 1⅜ in. | ribbed | 23 and 25 | 710° | 176° | 27,935 | 1,746 | 4,024 | 251½ | 9.48 | 3,370 | 6.96 | 8.01 | 29.99 |

* Lbs. of combustible consumed is less than amount of coal fired by amount of unburned coal picked out of ashes as well as by amount of ash. Unburned coal was given in the log of the trial, but is not reprinted here.

The trials lasted for 12 days, with a run of 8 hours on each day. The trials were begun by kindling the fire with 32.35 lbs. of wood and 150 lbs. of coal, and raising steam to 70 lbs. pressure. The pressure was kept at this point, and the water level at 7 ins. in the gage glass as nearly as possible during the 8 hours. On the trial of April 25 alone steam was kept at 100 lbs. pressure, and the water level was reduced to 3 ins. in the gage glass. This was done to obtain the heavy draft of 1 5/8 ins. of water which was used on that date. The forced draft was obtained by blowing off the steam through an escape pipe in the smoke-stack, and the water level was lowered to secure dry steam. At the close of each six-day trial

Full-Size Cross-Section of Serve Ribbed Boiler Tube

the soot was scraped from the tubes. From the plain tubes 2¼ lbs. was obtained, and from the ribbed tubes 3 lbs. was obtained.

The very remarkable increase in both fuel economy and capacity is summed up by Mr. ROELKER in the following table:

| Draft. | Pounds of coal burned per 100 lbs. of water evaporated. Plain tubes. | Ribbed tubes. | Gain by ribbed tubes in: Economy of coal. | Evaporation per lb. of combustible. | Increase in steam generated. |
|---|---|---|---|---|---|
| Natural draft, ⅛ in. | 19.72 | 13.65 | 30.83% | 57 54% | 18.03% |
| Forced draft, ⅛ in. | 16.7 | 13.21 | 21.08% | 32.68% | 30.97% |
| Forced draft, ⅞ in. | 21.37 | 14.8 | 30.74% | 46.84% | 46.46% |

The maximum amount of water evaporated in eight hours was 8,400 lbs. with the plain tubes, with a draft of 3/32 ins. of water, and 14,000 lbs. for the ribbed tubes with a draft of 1⅛ ins. of water. Although the draft was greater in the latter case, it is argued that as the increase of draft from ⅛ in. to ⅜ in. lessened the evaporation of the boiler when fitted with plain tubes, any further increase in draft would have caused no gain, so that the figure given, 8,400 lbs., is correct for the maximum capacity of the boiler with plain tubes. It thus appears that the Serve tube makes possible an increase in capacity by the use of forced draft of 65% over what is possible with the plain tubes.

The Serve boiler tube was described and illustrated in our issue of Nov. 8, 1890. It is the invention of a French engineer and consists in the addition of a number of longitudinal ribs to the interior surface of the tube, as shown by the accompanying cross-section. These absorb the heat from the gases, and greatly increase the evaporative power of the tube. Arrangements have been made for the manufacture of these tubes in this country, as the expense of importation under the present tariff is very considerable.

No tests of the tube have as yet been made on locomotive boilers, so far as we know, but the above results with forced draft, in a boiler not at all suited to its economical use, indicate strongly the gain in economy, and, what is much more important, in boiler capacity, which seems likely to be made by their use. The loss of heat in a locomotive boiler, owing to the great velocity with which the gases pass through the tubes, is very large, especially with fast passenger engines, whose boiler capacity is their weakest point as far as high speed with heavy loads is concerned. The results thus far attained by the Serve tube indicate that it is worth at least a careful trial in locomotive boilers.

## Vertical Lifts for Canals.*

I. *Ordinary Locks.*—The following *disadvantages* (many of them quite serious) are inseparably connected with the use of ordinary locks, the lift of which cannot advantageously be made greater than from 13 to 16 ft., a fact which renders them especially disadvantageous in cases where great differences of level have to be overcome:

(1) The cost of the construction. (2) The delay of traffic.

This delay is made up of the time occupied in actually passing boats through the locks, and of the time consumed by boats in waiting. The latter becomes relatively more important in canals doing a heavy business.

The great quantity of water required by the locks renders the supply of the necessary feed-water for the separate levels a most difficult problem, and many projected lines seem to be rendered impracticable simply because of the difficulty of feeding the upper levels; but even when the feeding of the summit level may be accomplished by means of natural streams, it seems incompatible with sound economy to withdraw such considerable quantities of water from industrial pursuits in an agricultural country, and allow it to flow through the locks without fully employing the energy stored in it. A portion of this energy, it is true, is utilized in lifting the upgoing boats, but, on the other hand, those going down waste the energy residing in themselves and in the water that fills the locks.

II. *Locks for Economizing Water.*—Projects have not been wanting for increasing the effectiveness of ordinary locks. Attempts to utilize the energy of the motion of the water flowing from the upper to the lower level, by introducing a motor operating a pump, have failed by reason of the variation of the available head, which seriously diminishes its usefulness.

The experiment has also been made of leading the water from the lock into a series of superimposed shallow lateral basins instead of into the lower level, the mass of water in the lock being thus divided into many thin layers, which were led, with as little loss of head as possible, into the lateral basins, and then back into the lock chamber when this was to be filled again. By means of such devices a material economy of water has been effected. But, notwithstanding this, they have met with but little favor, and the cause of this is to be sought, not only in the increased cost of construction, and the greater expense of maintenance due to complication of details, but also in the time lost in the slow filling and emptying, which greatly reduces the capacity of the canal. Locks coupled side by side give more favorable results, but their high cost of construction militates against their general adoption.

III. *Inclined Planes.*—Neglecting matters of detail, inclined planes may be grouped under two heads:

(1) With steep slopes (1:10 to 1:20), the plane is so short that, in order to equilibrate the weights of the up-going and the down-going loads, they may be connected by a rope passing over a pulley at the highest point of the plane. It is immaterial to our purpose whether the movement of the loads is effected by an excess of water in the down-going chamber, or by means of a motor applied to the pulley.

But the transmission of such great forces over a considerable distance, by means of the tensile strength of a rope or chain, subject as it is to wear, seems very precarious. In the overland canal in Germany, which employs this method, boats of 50 tons are handled, and the use of axle brakes has thus far averted serious accidents in cases of breakage of a rope, which are not altogether avoidable; but the safety of such a construction for boats of from 500 to 700 tons capacity is not yet proved.

(2) If the inclined plane is made with a flatter inclination, say of 1,200 to 1,500, the boat-wagon supported by a suitable number of axles may be drawn by a heavy locomotive over the plane after the manner of a freight train. Technically, it is no doubt possible to arrange and maintain the inclined plane and the motive power so that a safe and regular service may be expected. Economically, however, it seems unjustifiable to undertake the movement of such great masses (which on main lines may amount to at least two million tons yearly) in such a way that the energy of the down-going loads must be destroyed by brakes, and the up-going loads must be lifted at great cost.

A calculation based upon the maximum dimensions of locks established for the Prussian canals indicates that locomotives of between 500 and 600 HP. would there be required for this purpose.

Finally, the limited capacity of this construction must be taken into account. If we attempt to increase the velocities we are met by the danger of swaying of the contents of the lock, to say nothing of the colossal dimensions which must then be given to the locomotives.

We may then sum up the results of this section as follows: That inclined planes do indeed conduce to a great economy of water. But, on the other hand, if they are constructed with a steep grade they do not afford the required safety in operation, and, if built with a gentler slope, they do not satisfy the requirements of a large canal as to cheapness and rapidity of transport.

IV. *Greve's Lock.*—On page 198 of the *Centralblatt der Bauverwaltung* for 1886 is a description of GREVE'S lock. This consists of two channels, sloping at 1.20, and placed one alongside of the other. In these channels move wagons, running upon wheels, and having water-tight bearings against the walls of the channels. Floating in the water, backed up by one of these wagons, a boat can be transferred from one level of the canal to another. The two wagons are connected by a chain passing over a pulley at the highest point of the slope. The motive power consists of an excess of water behind the down-going wagon, and is regulated by brakes.

It cannot be denied that Greve's lock is technically feasible, and has the advantage of simplicity of construction, but, on the other hand, the construction of the long channels, with their parallel walls, and the necessity of constant attention to the water-tight joints between them and the wagons, must be regarded as a serious drawback; so that a comparison of this design with that described under III, must result favorably to the latter.

Furthermore, what has already been said as to the undesirability of employing a long rope or chain subject to wear, applies also to this design; so that, while it must be regarded as an interesting solution of the problem, it cannot be recommended for adoption.

V. *Vertical Lifts at Anderton, Les Fontinettes and La Louvière.*—The foregoing considerations appear to be confirmed by the fact that none of the contrivances above

* An address delivered before the Centralverein zur Hebung der deutschen Fluss-und Kanalschiffahrt, by OSCAR W. PETRI, Königlicher Regierungs-Baumeister in Magdeburg.

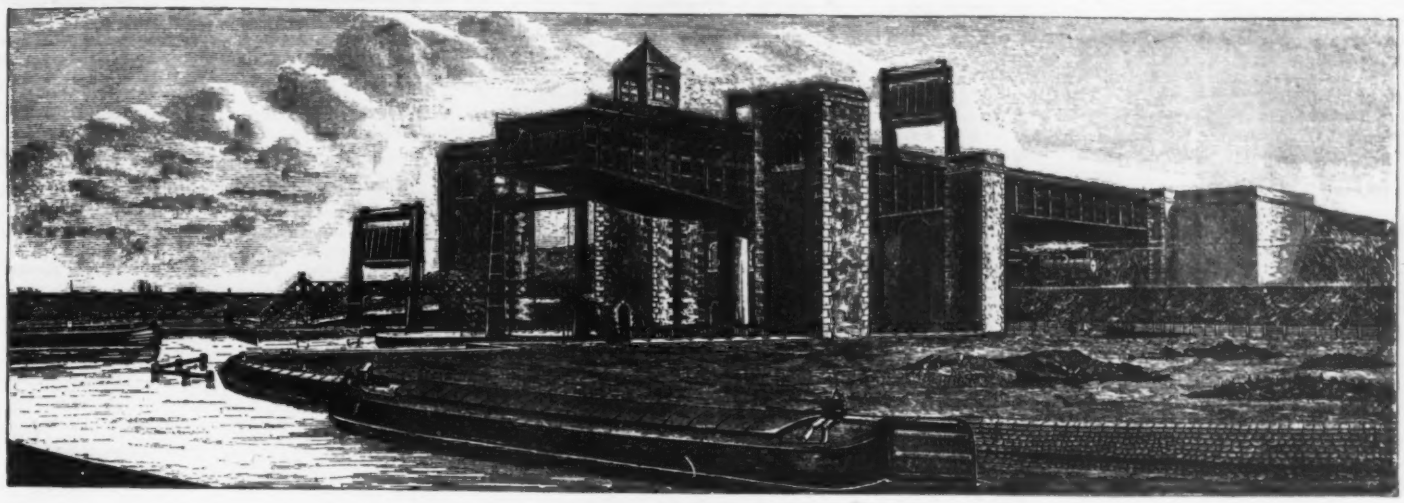


FIG. 1. HYDRAULIC CANAL LIFT AT LES FONTINETTES, FRANCE.

described have displaced the ordinary lock in any extensive canal system of modern times. We find rather that vertical lifts are coming more and more into use and seem destined to play an important part in canal construction in the near future.

Starting with the admission that an equilibration of the down-going and up-going loads is an economic necessity, two lock chambers were provided, which, in the first experiment on the Grand Western Canal, were connected by a chain passing over pulleys. But the difficulties noted under III. and IV. led to the abandonment of this construction and to the connection of the two chambers by an apparatus working by pressure and not exposed to wear, viz.: a system of two hydraulic pressure cylinders, with a pipe connection between them. Under each chamber was placed a vertical plunger, and the two cylinders in which they worked were connected by a pipe provided with a valve. When this valve is opened, the arrangement works like a great hydrostatic balance. The two chambers would be set in motion by giving to one of them an excess of water over the other. It is to be observed that this excess serves only to overcome the friction at the stuffing boxes and to accelerate the two masses, and is therefore quite inconsiderable.

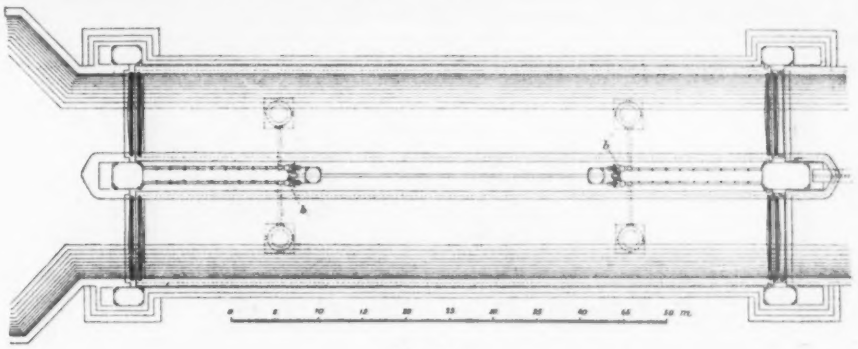


Fig. 4.

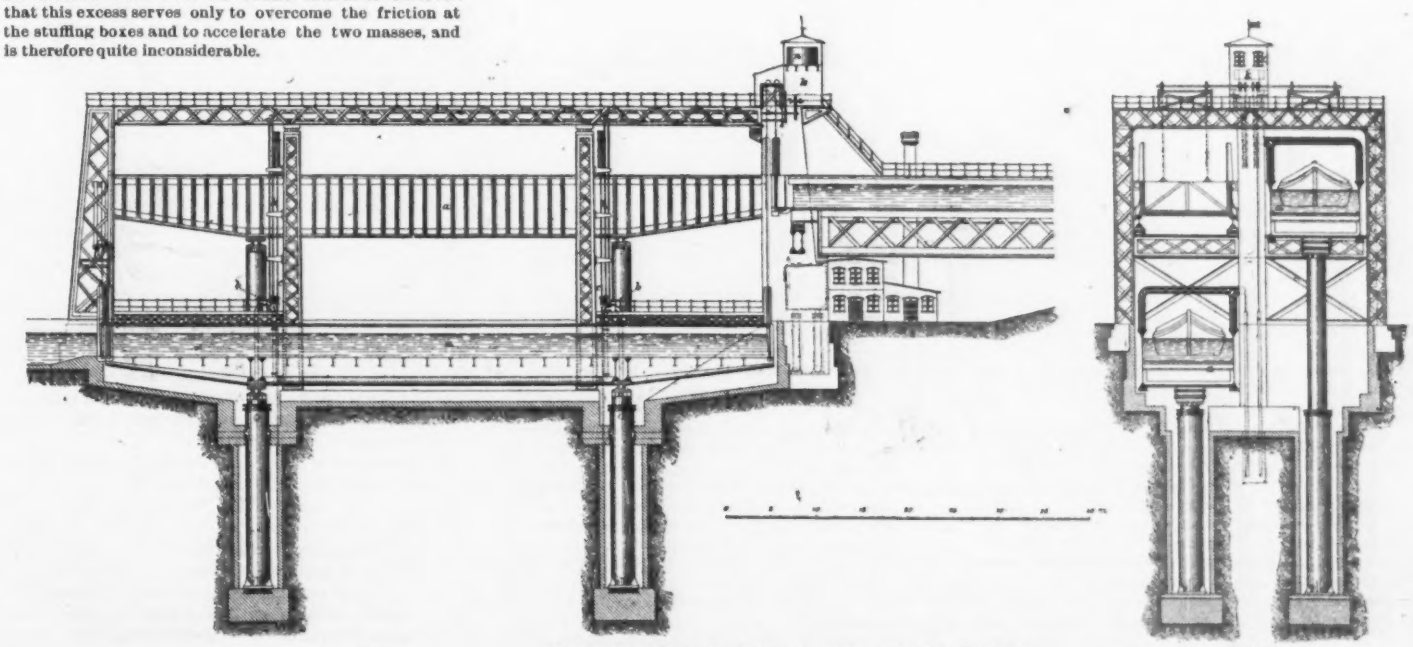


Fig. 2. TWO-CYLINDER VERTICAL LIFTS; HOPPE SYSTEM. Fig. 3.

The following table gives the dimensions of the three vertical canal lifts now in operation in which the two masses are equilibrated by means of water under pressure:

| | Anderton. | Les Fontinettes. | La Louvière. |
|---|---|---|---|
| Length of the lock-chambers. | 77 ft. | 133 ft. | 141 ft. |
| Width of the lock-chambers. | 15 ft. | 17 ft. | 18.4 ft. |
| Depth of water in lock-cham. | 5 ft. | 6.6 ft. | 8.5 ft. |
| Lift of lock-chambers ..... | 49 ft. | 43 ft. | 55.5 ft. / 50.5 ft. |
| Weight of the boats..... | 100 tons. | 300 tons. | 400 tons. |
| Weight of the load on the plunger..... | 250 tons. | 770 tons. | 1,1°0 tons. |
| Diameter of plunger..... | 3 ft. | 6.6 ft. | 6.6 ft. |
| Pressure of water..... | 38 atmos. | 25 atmos. | 35 atmos. |
| Water for one lockage..... | 530 cu. ft. | 706 cu. ft. | 971 cu. ft. |
| Time consumed in one lockage..... | 8 min. | 6 to 8 min. | ? |
| Cost of construction, total... | $240,000 | $363,000 | ? |
| Cost of construction, for iron | $147,500 | $163,000 | ? |
| Cost of operation..... | $50 per week. | ? | ? |
| Number of existing or contemplated lifts..... | 1 | 1 | 4 |

The firm of Clark & Standfield, in London, the builders of these plants, are also engaged at present upon similar designs for a canal from London to Birmingham. In France, an extension of this system is in contemplation for a canal joining the Loire with the Garonne. It is the intention there to establish two lifts, one immediately following the other, and each with a rise of 134.5 ft.*

The lift at Anderton has been in operation since 1875, and gives perfect satisfaction. It is surprising how exactly the center of gravity of the total load coincides with the axis of the plunger, so that only quite inconsiderable pressures come upon the guides. That this is really the case, and that no material lateral pressures are exerted, is evident from the appearance of the guides themselves, which remain coated with thick layers of lubricating material.

**Centralblatt der Bauverwaltung.* 1882; Bellingrath, Studien, Berlin, 1879; Ernst, Hebezeuge, Berlin, 1883; *Engineering*, July, 1885; *Le Génie Civil*, Paris, Dec. 13, 1883.

On Aug. 18, 1881, after 6 years' operation, an interruption occurred through the breakage of one of the main cylinders at the point of attachment of the connecting pipe. Upon investigation it was found that the machinist in charge, without the knowledge of the superintendent, had constructed a rigid support under the connecting pipe for the purpose of supporting it. The cylinder had settled in the course of years, and, the connecting pipe being prevented by the support from sharing in this motion, the socket at the junction broke off with a portion of the cylinder cover; but the damage was not so great as might be supposed, for the upper chamber sank with a moderate, though accelerated speed. This is accounted for by the fact that only so much water can escape from the cylinder as can flow through the annular space between plunger and cylinder.

Such serious errors in the construction and maintenance of the apparatus must in future be made impossible in works of such magnitude. At the exhibition of designs

for the Belgian and French governments, the dominant consideration was that in the present state of technical science it is possible so to plan and construct all the parts that they shall afford the same security as any other construction, such as a railroad bridge or a large iron column. In such works, the destruction of which, would also be most disastrous, no one thinks of providing automatic safety appliances for accidents; and, similarly in the design of canal lifts the object should be rather to provide a simple construction, the stresses in every part of which can be accurately determined and the parts themselves perfectly maintained in their original condition.

The lift at Les Fontinettes Fig. 1, was opened on April 19, 1888, and during the first month of its operation an average of 40 boats daily were locked through by means of it. The time required for a lockage is from 6 to 8 minutes.

VI. *Vertical Lifts on German Canals*—The fact that vertical lifts have not yet been adopted in Germany is no doubt due in part to the great dimensions required for the locks there. These render it necessary to provide more than one support for each chamber; for we cannot materially increase either the diameter of the plunger or the pressure of the water under it, but, owing to the unequal resistances and loads, two or more plungers, if employed, would not travel at precisely the same rate, unless special means be provided which will maintain the lock chambers always in a horizontal position. The designs shown in Figs. 2-4, intended for a lock 237 ft. long, 29.5 ft. wide and 8.2 ft depth of water, were, at the suggestion and with the assistance of the author, developed and worked out in all their details by the engineering establishments of C. HOPPE in Berlin and GRUSON in Magdeburg. They demonstrate the applicability and usefulness of vertical lifts for the largest canal boats.

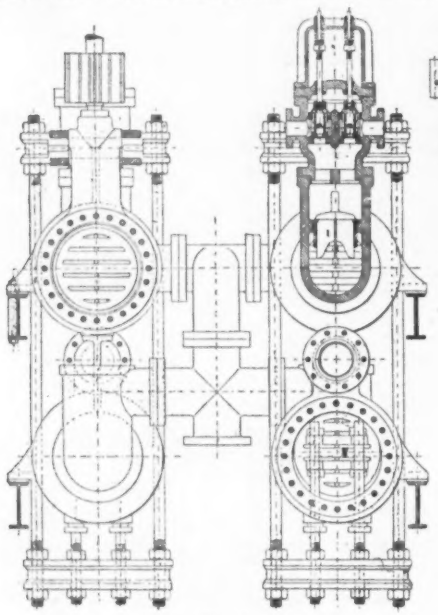


Fig. 5.

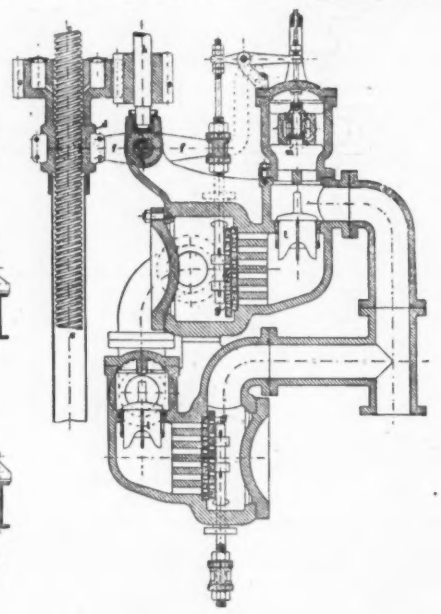


Fig. 6

HOPPE VALVE GEAR.

The lift shown in Figs. 2-4 consists of 2 movable lock chambers *a*, each of which is supported by two plungers of 6.56 ft. diameter, with a water pressure of from 35 to 40 atmospheres. The ends of the chambers, as well as those of the upper and lower levels, can be closed by gates worked by hydraulic power; and the joints between the chambers and the ends of the canal levels are made watertight by packings of hose in which water pressure is maintained by connection with the reservoir *n*.

This cutting off of the lower as well as of the upper level, avoids a defect of the Anderton lift, viz., that the descending chamber is immersed in the water of the lower level, and its buoyancy must be overcome by water pressure derived from a special accumulator.

The lift is so arranged that the water surface in the chamber when at the top of the lift is 6 ins. below that of the upper level, and when at the bottom is 6 ins. above that of the lower level. The 6 ins. excess in the upper chamber furnishes the motive power for overcoming friction, and for giving a velocity of 4 ins. per second. When the gates are opened, these differences of levels are equalized, and the boats can pass out or in as the case may be. Hence, with a chamber 236 ft. long and 29.5 ft. wide, the consumption of water for one lockage is $236 \times 29.5 \times 0.5 = 3{,}460$ cu. ft. It is to be observed that this quantity is constant, whatever be the height of the lift, and serves for the moving of *two* vessels, one going up and the other coming down.

The time required for a lockage is: For entering and leaving the lock, 12½ min.; for the actual lifting, 2½ min., total, 15 min.

At the beginning of the operation of lifting, the pressure under the descending plunger exceeds that under the ascending one by 2.8 atmospheres. At the end of the operation this excess is reduced by the change in the buoyancies of the plungers to one atmosphere.

The fundamental condition for a perfect manipulation of the lift is that the two plungers under each chamber shall move up and down with perfect uniformity, quite independently of the load upon each and of the friction in the stuffing boxes, and that they may be simultaneously brought to rest in any position.

This condition is fulfilled in the simplest manner and with perfect security by means of several hydraulic presses in Hoppe's patented valve motion for parallel lifting. This firm has been engaged for years in the study of this problem, and has used this method for lifting a bridge over a canal in Berlin. At present they are engaged in raising a gasometer roof with the aid of 32 cylinders provided with this valve motion. The arrangement is indicated by the letter *b* in Figs. 2 and 4, and is shown upon a larger scale in Figs 5-7.

The cast-iron valve box, and with it the fulcrum of the lever *f*, are fixed in position between the two lock chambers. By means of a rod, one arm of the lever *f* moves the side-valves *g*, which establish or cut off communication between the 4 pressure cylinders. Each cylinder must have 2 slide-valves, since the chambers rise and fall alternately.

The other arm of the lever carries the nut *d*, and the bolt *c*, Fig. 2, is connected with the movable lock chamber, and is of a length corresponding with the height of the lift. When the lever *f* is horizontal, the slide valves are closed and the system is at rest. But as soon as the lever *f* is brought into an inclined position by turning the wheels *o*, and thus moving the nut *d* upon the bolt *c* (which is now stationary), one of the valves opens, and the lock chamber, and the spindle *c* begin to move. This raises or lowers the nut *d*, again bringing the lever *f* horizontal, so that the valves cut off. In consequence of this differential movement, the lock chamber can move only with precisely the same velocity as the nut *d*. By means of the shafts, *h* and *i*, with bevel gearing, the separate valve gears of each of the 4 cylinders are so connected that they must work in concert, so that all the nuts *d*, and with them all of the plungers, must move together and with perfect uniformity.

The shaft *i* is controlled from the platform *k* by means of a hydraulic motor. When it is turned, the lock-chambers begin to move; and when it is brought to rest, they come to rest also.

Return valves *l* are arranged behind the slide-valve in order to prevent the latter from working in the opposite direction. Of the upper valves *m*, one is in communication with the air, and the other with the pressure main. They serve as a safeguard against excessive pressure, and permit a variation of the contents of the pressure-cylinder by bringing water under pressure from an accumulator when the water in the cylinder has lost pressure through leakage in joints or when it is required to vary the height of lift to accommodate variations in the level of the canal. They also prevent the racing of a plunger in the case of great irregularities. The play given to the slide-valves before they open the auxiliary valve is determined by the maximum obliquity of the lock-chambers and amounts to about 2 in. The movement of the slide-valve is indicated upon a dial on the engineer's platform, so that he can regulate the motion and at once detect any irregularities.

To allow for expansion and contraction under changes of temperature, the principal guides for the lock chamber are placed at one end only, viz.: in the columns of the frame at the up-stream end of the lock, while the down-stream frame serves as a lateral guide only. Contraction and expansion are also provided for in the connection between the chambers and the plungers.

As at La Louvière, the pressure cylinders in the HOPPE design are of cast iron, in lengths of 6.6 ft., with steel rings shrunk on. The pipes joining the cylinders are provided with flexible joints and so arranged that variations in the lengths or positions of the cylinders cannot act injuriously upon any joints or cause fracture of the pipes.

The middle column of the principal frame is a hollow column of plate iron and contains 2 accumulators for operating the valve motion, the capstans and the wind lasses for raising the gates, as well as for keeping the cylinders full of water. The water pressure is maintained by a force pump, driven by a steam engine.

The cost of construction, as shown by the following estimate, will reach about $393,000.

| | |
|---|---|
| The entire plate work, consisting of the lock-chambers, frames, foot-bridges, etc | $121,000 |
| 8 Lock gates with frames | 12,000 |
| 4 Pressure cylinders with plungers and attachments | 135,000 |
| Wrought iron beams supporting the cylinders | 5,000 |
| 4 Valve-motions with motors and pipe connections to the cylinders | 25,000 |
| Steam engine, with force pump and 2 accumulators, and piping in engine house | 14,000 |
| 8 Spindles for the sluices, 2 capstans, piping for same, signals, calking, etc | 15,000 |
| Total of iron work | $327,000 |
| 30,000 cbm. earthwork and shafting at 75 cts | 22,500 |
| 5,000 cbm. masonry at $7.50 | 37,500 |
| Engine house and dwellings for employees | 6,000 |
| | $393,000 |

## Shops and Yards of the Union Pacific Ry. at Cheyenne, Wyoming.

We are indebted to Mr. THOS. APPLETON, Engineer of Buildings of the Union Pacific Ry., for the accompanying map, showing the proposed arrangement of shops and yards for that road at Cheyenne, Wyo.

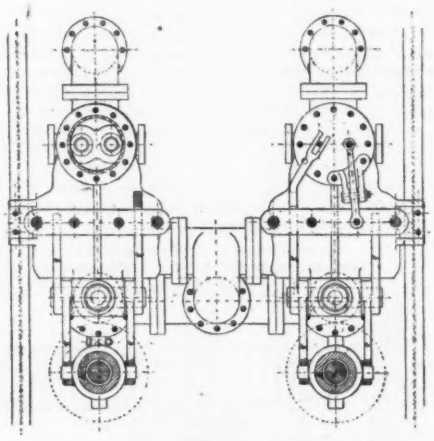


Fig. 7.

HOPPE VALVE GEAR.

Cheyenne is the eastern terminus of the Wyoming division and the western terminus of the Nebraska division of the main transcontinental line. Here also the line running north from Denver meets the main line, and a branch runs from here north about 170 miles.

The main line of the Union Pacific, from Omaha to Cheyenne, is perhaps the longest stretch of low-grade railway in the country. For the entire distance of 516 miles there is no grade of over 30 ft. per mile. From Cheyenne west to Sherman, a distance of 37 miles, there is an almost continuous grade of 70 ft. per mile. These peculiar features make Cheyenne an important division point. Trains from the west have to be sorted out for the east and southeast and put together in longer trains, while west-bound trains are made up from those arriving from the east and south, and are either reduced in length or have their motive power doubled up.

In consequence of the increase of business it was decided two years ago to increase the shop facilities and yard room at Cheyenne. The engraving shows the position of the new shops, buildings and tracks. The old machine shop has been converted into a boiler shop, and the old blacksmith shop is now used for a copper and tin shop. The following new buildings and structures have recently been built: Roundhouse, coal chute and water tank, sandhouse, oil-house, ashpit, machine and erecting shop, blacksmith shop, hammer shop, paint shop, car-erecting shop, woodworking shop, freight-car repair shop; also an office building for the Superintendent of Motive Power and his staff. A large storehouse is about to be constructed, and it is intended to build

a large iron foundry in the space south of the coal chute. Two transfer tables operated by electric motors have also been put in. A handsome stone passenger station was constructed about three years ago. The shop buildings are of brick with sandstone trimmings. They are of substantial though not expensive construction, and well adapted to their several uses.

The coal chute has 40 pockets, and is of the Clifton patent; the ashpit is double with a depressed track in the center for the use of cars in which to load cinders. It is intended at some future time to add 12 stalls to the new roundhouse. The machine shop contains 10 tracks, and space is reserved to extend it at some future time to double its present length. It contains an overhead traveling crane of 50 tons capacity, made by the Shaw Electric Crane Co. It is operated entirely by electricity. With this crane a locomotive can be raised and the wheels taken out from under it in a short time.

All the shops are lighted by incandescent electric lights. A 1,000-light dynamo and engine plant is located in the machine-shop engine-room. There is a separate dynamo for generating power for the crane and the transfer tables. The switchboard is so arranged that power can be furnished by the light dynamo or light by the power generator, if so desired. A 500-light plant is located in the engine room of the woodworking shop. Excellent water is furnished from the city water-works, the shops and grounds being supplied by a system of 6-in. and 8-in. cast-iron pipes with numerous fire hydrants. Each building is drained by sewer connections with the city sewer system. Ample space is reserved for additional buildings and repair tracks when increase of business may require them. Between the shops and main track is a switching-yard, only part of which is at present constructed. This yard is divided into two parts for east- and west-bound freight trains.

The entire work was constructed under the direction of Mr. V. G. BOGUE, Chief Engineer. The shops were designed partly by Mr. WM. LUSH and partly by Mr. THOMAS APPLETON, Engineer of Buildings, under the direction of Mr. G. W. CUSHING, formerly Superintendent of Motive Power for the Union Pacific Ry. The switching-yard was designed by Mr. APPLETON. A viaduct connecting the northern and southern portions of Cheyenne is now being built by the city to carry Central Ave. across the middle of these grounds.

As a matter of interest in connection with the design of railway terminal yards attention may be called to the relative merits of the longitudinal and radial types of engine-house. In laying out the yards here shown, the practically universal American practice has been followed of making the engine-house of the segmental type, all the tracks radiating from a turn-table at the center. The advantages of this plan in permitting any engine in the house to be taken out without moving any other, and in the matter of good lighting and ventilating and ease of construction, are well known. The disadvantage, which has sometimes caused serious loss, is that a failure of the turn-table, or a derailment of an engine in passing on or off it so as to prevent its moving, prevents all entry to or exit from the roundhouse until the trouble is remedied. In a paper by Mr. J. DAVIS BARNETT, Superintendent of the Stratford shops of the Grand Trunk Ry., in our issue of Oct. 19, 1889, on the "Design of Railway Shops," the longitudinal system of engine-house construction was strongly recommended, both for this reason and for the celerity with which locomotives can be brought out of the house at busy terminals during rush hours.

In recent issues (Jan. 24 and Feb. 14) we have recorded two cases of heavy fire loss due to the blocking up of the single exit over a turn-table from the segmental of engine-house; and cases have also occurred where traffic on a railway has been seriously blocked for many hours through the same

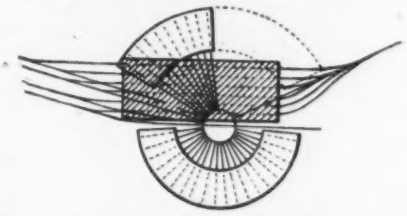


Fig. 2. The Longitudinal and Radial Types of Engine House Compared.

cause, occurring at a time when the roundhouse was full.

To show the small space occupied and the compactness of the longitudinal type of house, compared with the radial, we have drawn a plan of one, in Fig. 2, of the same capacity (30 engines) as the one at Cheyenne, sketching on also the present Cheyenne roundhouse, more fully shown in Fig. 1. The rectangular building might have 6 parallel tracks, and, if 280 ft. long, could accommodate 5 engines on each track. With exits at both ends, as shown, no more than two engines would ever have to be moved to take out a locomotive. As a matter of fact, however, where the longitudinal type of house is used it is seldom necessary to move a locomotive to get another out. A little care in placing the engines as they come in leaves them in the right order for exit without interference with each other.

Probably the difficulty in securing good light and in constructing the roof to permit ready escape of smoke has had much to do in preventing the use of the longitudinal type of house in America. With the exception of two on the Grand Trunk (one at Montreal with a capacity for 25 engines), we know of no engine-houses of this type in America. In England, however, both this type and the radial type of engine-house are in use, and each has strong advocates among railway men.

The present tendency in shop construction in this country is toward the more general use of the rectangular system of tracks, a movement which has been facilitated by the improvements in transfer-tables and the application of electricity to their propulsion. Perhaps this may be followed by more general use of the rectangular system for engine-sheds.

## Increase in Population and School Enrollment.

The accompanying table, on which we have commented briefly in another column, is not only of much interest in itself, but tends somewhat to support the correctness of the 1890 census, which we and others have questioned. These two causes together lead us to publish it, though it is only in a remote sense "engineering news."

COMPARATIVE INCREASE PER CENT. IN POPULATION AND SCHOOL ENROLLMENT IN 35 STATES AND TERRITORIES.
[Abstracted from Census Bulletin No. 53.]

| NORTHERN STATES. | Per cent. gain in population. | Per cent. gain in public school enrollment. |
|---|---|---|
| Connecticut | 19.84 | 6.68 |
| Delaware | 14.93 | 19.01 |
| District of Columbia | 29.71 | 39.59 |
| Illinois | 24.32 | 10.55 |
| Iowa | 17.68 | 15.88 |
| Maine | 1.87 | 7.38 |
| Maryland | 11.49 | 22.85 |
| Massachusetts | 25.57 | 17.33 |
| Michigan | 7.92 | 17.82 |
| Minnesota | 66.74 | 51.10 |
| New Hampshire | 8.51 | 7.51 |
| New York | 18.09 | 1.78 |
| Ohio | 14.83 | 5.98 |
| Pennsylvania | 22.77 | 4.59 |
| Rhode Island | 24.94 | 27.49 |
| Vermont | 0.04 | 10.42 |
| Wisconsin | 28.23 | 16.97 |
| Arithmetical average | 21.02 | 13.47 |
| SOUTHERN STATES. | | |
| Arkansas | 40.58 | 106.10 |
| Louisiana | 19.01 | 53.52 |
| Mississippi | 13.96 | 47.90 |
| North Carolina | 15.59 | 27.08 |
| South Carolina | 15.63 | 50.89 |
| Texas | 40.44 | 133.15 |
| Virginia | 9.48 | 55.06 |
| West Virginia | 23.34 | 34.42 |
| Arithmetical average | 22.25 | 63.51 |
| WESTERN STATES. | | |
| Arizona | 47.43 | 85.85 |
| California | 39.72 | 37.33 |
| Montana | 237.49 | 260.12 |
| New Mexico | 28.46 | 283.07 |
| North Dakota | 395.65 | 722.77 |
| Oregon | 79.53 | 69.23 |
| South Dakota | 234.60 | 563.36 |
| Utah | 44.42 | 41.02 |
| Washington | 365.13 | 275.05 |
| Wyoming | 192.01 | 142.59 |
| Arithmetical average | 166.38 | 248.04 |

[N. B.—These averages are made abnormally great by two or three exceptionally heavy percentages which apply to only a small population.]

## Interchange of Freight Cars at Chicago.

The following statistics showing the magnitude of the freight car movement at Chicago were presented by Mr. P. H. PECK, Master Mechanic, Chicago &

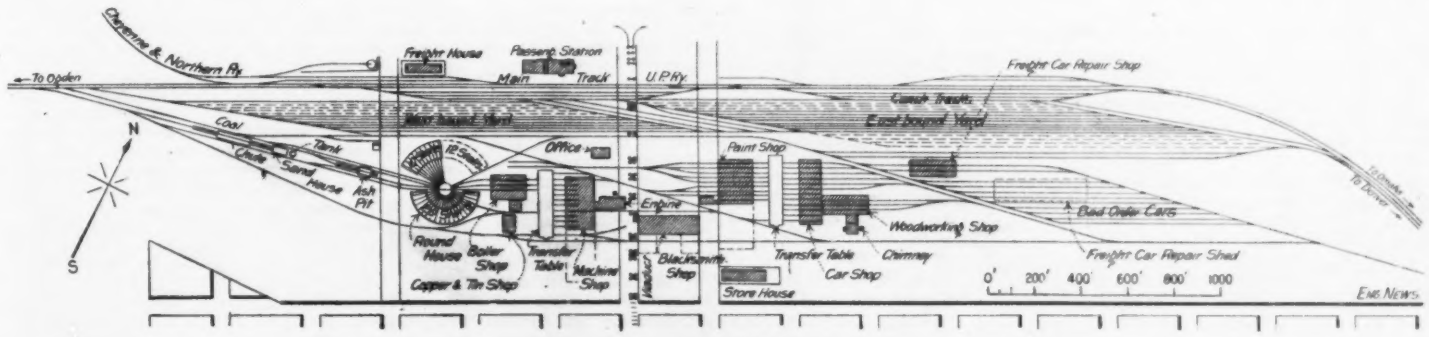



FIG. 1. YARDS AND BUILDINGS OF THE UNION PACIFIC RY., CHEYENNE, WYO.

Western Indiana R. R. and Belt R. R. of Chicago, at the meeting of the Western Railway Club on April 21. The statistics were collected from the general freight agents of the 21 roads entering Chicago, and are for the month of November, 1890. Some roads did not report; but a sufficient number did report to make possible a fair estimate.

I find that there were delivered into Chicago 231,811 cars during November, 1890, a daily average of 10,069 cars. There were transferred to other lines 146,212 cars, or a daily average of 5,613 cars.

Averaging the length of the cars from end to end of drawbar at 32 ft. per car, the daily average brought into the city is a fraction over 61 miles of cars. There were over 34 miles of cars transferred during the same time. Calculating the day at 24 hours long, there were 419 cars brought into the city and 234 transferred during every hour of the day.

I have also addressed letters to the heads of car departments or those having charge of the departments in the city, asking them for the number of car inspectors and car repairers employed on freight cars. I have replies, from all of those addressed, which showed that there

were 256 inspectors, 1,463 car repairers, and 27,979 cars repaired during November, 1890. Deducting the Belt, Chicago & Calumet Terminal and stock yard inspectors, we have left 210 men to inspect daily 10,069 cars, or about one man to 48 cars. Estimating the pay of the men at $50 per month, the cost is shown to be 4 cents per car for inspection alone, which sum I think is too much. The daily average of cars repaired is 1,076, or 107 per hour, or 1¾ cars in every minute.

I asked for the number of drawbars broken, but most of the roads did not keep this record in 1890. The Belt Ry. broke 1 drawbar to every 273 cars handled (though this year, so far, we are breaking less). Taking that figure as a basis, there are 36½ drawbars broken daily in our interchange.

The above figures do not include the repairs of all cars actually broken in the city, as many of the car shops are located elsewhere.

In the same month, November, 1890, over 50% of the cars transferred by the Belt road were more or less defective. I have the reports of the number of cars that the Belt road has records against. The lowest per cent. received in defective condition is 20; the highest is 82$^{6}/_{10}$%, and if M. C. B. cards had been given for all defects in the month of November, there would have been 2,888 cards issued daily. I think it would have been impossible to issue this number, especially under the present system of inspection. Cars would be detained too long, and we would have extra switching and double inspection. This work could be done, however, under a system of joint inspection, controlled by one chief located in the city, the same as the car service association is operated at present. It would require some trouble and attention from the heads of car departments to get such an inspection system into shape, but I think it is at least well worthy of a trial.

## PERSONALS.

Mr. T. H. McKoy, Jr., of Asheville, N. C., has been elected President of the Morristown & Cumberland Gap R. R.

Mr. W. J. Beatty, Engineer on the Pittsburg, Ohio Valley & Cincinnati R. R., died at Columbus, O., recently.

Mr. C. F. Kohlman has been re-elected City Engineer, and Mr. P. H. Connally, Assistant City Engineer, of Racine, Wis.

Mr. J. A. Quinn has been appointed Master Mechanic of the Clifton Forge shop and terminal of the Chesapeake & Ohio Ry.

Mr. Robert Gamble has been appointed Assistant Superintendent of the Charlotte Harbor division of the Jacksonville, Tampa & Key West Ry.

Mr. M. A. Verner, General Manager of the Buffalo St. Ry. Co., Buffalo, N. Y., has resigned, and will be succeeded by Mr. Littell, of Louisville, Ky.

Mr. Max E. Schmidt, M. Am. Soc. C. E., of Chicago, Ill., has removed to the rooms of the Multiple Speed & Traction Co., Lake Side Building, Clark and Adams Sts.

Gen. H. P. Van Cleve, who died at Minneapolis, Minn., April 24, aged 81, was an engineer in the service of the State of Michigan in 1855, and later a United States surveyor of public lands in Minnesota.

Mr. Samuel M. Rowe has resigned his position as Chief Engineer of the Atlantic & Pacific R. R., and has been engaged to locate a narrow gage line from Coolidge, N. M., to the Zuni Mountains. The line will be about 100 miles long.

Mr. Sheldon T. Bent has been appointed Engineer of Maintenance of Way of the Kentucky Union Ry., with office at Clay City, Ky., vice Mr. J. K. Snarfe resigned. He will have charge of road department, bridges, buildings and water supply.

Mr. Mace Moulton, M. Am. Soc. C. E., has resigned his position as Consulting Engineer of the Berlin Iron Bridge Co., East Berlin, Conn., and accepted the position of Manager and Engineer of the R. F. Hawkins Iron Works, Springfield, Mass.

Mr. R. N. Ellis has resigned his position as City Engineer and Superintendent of Water-Works at Jacksonville, Fla., and has accepted the position of General Manager of the National Peace River Phosphate Co., with offices at Jacksonville, Fla.

Mr. W. D. Williams has been appointed Chief Engineer of the Cincinnati, Jackson & Mackinaw R. R., with headquarters at Van Wert, O. He will have full charge of maintenance of way, bridges and buildings. Mr. Williams has been for 2 years past Assistant Engineer of the Wheeling & Lake Erie R. R.

Gen. Geo. S. Greene, with one exception the oldest living graduate of West Point, and one of the founders and the oldest living member of the American Society of Civil Engineers, attained his 90th birthday on Wednesday, May 6, and the occasion was celebrated by a dinner at the Century Club tendered to Gen. Greene by his fellow members and friends, which the General himself attended with great enjoyment and without undue exertion or fatigue despite his great age. There can be but few men living of his age who retain their strength and faculties so well, and it will be the universal wish of all who know him, that he may live to celebrate the still more rarely attained anniversary ten years later, as he bids fair to do as much as any one ever has, perhaps, at his age.

## NEW PUBLICATIONS.

—*May Magazines.*—No one of the May magazines contains any article of especial technical interest, the most interesting, perhaps, being an article in *Harper's* on "Roman London," which gives a detailed and vivid picture of the high state of civilization in England under the Romans, which was destined to be so soon extinguished and not again attained for so many centuries, if, indeed, it can be said to have been attained in some respects even now. The public and private works of Roman England were on a much larger scale than is generally realized.

The *Century* contains some interesting but not specially new information on "Visible Sound" and the laws of sound generally, and an exceedingly interesting article on "Pioneer Mining in California," in which the rise and fall of hydraulic mining is also briefly described. There is room for a grand illustrated article on that kind of mining alone, which is now all but a thing of the past, owing to prohibitory laws, but which was, from every point of view, a remarkable innovation, which has permanently added to the resources of engineering as well as to the world's stock of gold. Merely for mining gold the process is not likely to be ever again permitted in California, owing to the wholesale destruction of valuable bottom lands and changes in the channels of streams which all but inevitably follow, but for purposes of moving material it will continue to be used extensively when conditions are favorable.

The *Forum* contains three very interesting articles: "Chemistry To-day and its Problems," by Prof. Wm. Crookes, chronicles, among many other interesting facts, the alleged discovery of a new element, "damarium," said to have been discovered issuing from the ground in Damara Town, South Africa, and said to be considerably lighter than hydrogen. "Southwestern Harbors and Gulf Commerce," by Senator Frye, contains a very good and clear summary of the improvements there proposed or under way. "The United States Census," by Ex-Supt. Francis A. Walker is devoted to general questions and not to the alleged imperfections of the last enumeration, but forcibly points out the impediments to accurate enumeration.

The *Popular Science Monthly* contains one article, on "Ice-making and Machine Refrigeration," of considerable engineering interest, and it might have been made far more so by the addition of a dozen or twenty lines in various parts giving some definite facts as to the cost and efficiency of the process. As with so many articles of this "popular" type, however, the author makes its popular form an excuse for using mere vague descriptions, and silently passing by his opportunities to convey accurate information as well as to satisfy a vague superficial curiosity. In other words, the author has written only what he could without trouble, and without committing himself to accurate facts, which it would take some trouble to determine.

*The North American Review* contains a gratifyingly hopeful article by Mr. Henry Clews on "Our Business Prospects," of which he takes a cheerful view both for the immediate and distant future. He considers that New York is destined in the near future to become the financial center of the world, and thinks the late Baring fiasco has brought this possible future visibly nearer.

—*Surveying and Leveling Instruments* theoretically and practically described for Construction, Qualities, Selection, Preservation, Adjustment and Uses; with other Apparatus and Appliances used by Civil Engineers and Surveyors. By Wm. Ford Stanley, optician, manufacturer of surveying and drawing instruments, author of a treatise on Drawing Instruments, Properties and Motions of Fluids, etc. London and New York: E. & F. N. Spon. 12mo, pp. 552, 345 cuts, $3.

This is another of those handsomely manufactured engineering works of English origin, on whose superior typographical style to that common in this country for *engineering* works we have had occasion to comment so frequently of late. Both the style and substance of the book are admirable (except that the binding is rather tawdry), and we can heartily commend it to those interested in the details of instruments and of field work, as by far the best work in the language on its subject, so far as we can now recall. The engravings are in general admirable, a wretched and sole exception appearing on page 165.

The author is one having that intimate knowledge of instruments which a manufacturer of standing must needs have; but he is more than a mere manufacturer, and his book is much more than the indirect puff of his own goods which we half expected to find it. The puffing element, in fact, is all but wholly absent, and, to all appearance at least, the book is an honest attempt to make public for general advantage the results of experience, and study of, a somewhat complex art, which concerns many who have no opportunity to gain practical knowledge of it. If he be not mis-revealed in his own book the author is clearly one of these "finishers" to whom Emerson so pithily refers: "In every variety of human employment, among the numbers who do their work perfunctorily, as we say, or just to pass, and as badly as they dare, there are the workingmen, on whom the burden of the business falls—those who love work, and love to see it rightly done, who finish their task for its own sake; and the state and the world is happy that has the most of such finishers.' Among the multitude of works which are issued from the press with the apparent sole purpose of advertising the writer's goods or his (half) knowledge, or for securing to him the reflected glory of authorship, it is a genuine pleasure to come across a work which appears to have been written from abundant knowledge, and from honest interest, rather than to blow the author's horn.

The work is divided into 16 chapters, which are devoted in order to an historical and general summary, to the telescope, magnetic compass, levels, leveling staves, division of the circle, theodolites, mining instruments, stadia instruments, reflecting instruments, portable altitude instruments, plane-takes and other graphical instruments, chains and measuring instruments, stations and signals, barometrical instruments, and miscellaneous instruments and appliances. Throughout all these chapters we notice some practical hints which are new to us, like that reproduced in another column, and many cuts and descriptions showing various facts about instruments and their use more clearly than we have seen them set forth in print before. We cannot indicate our general impression of the work better than to say that it strikes us as an excellent one to put in the hands of engineering students, to enable them to get that initial comprehension of the theory of instruments and instrumental work which will be useful to them all their lives, but with all the details of which it is hardly necessary to burden their memory, especially as many of the instruments described in this book will rarely or never be seen in this country. The student will learn from the volume many a useful fact about field work along with what he learns about instruments.

The cloven foot sticks out a little at the end of the volume, where there is given a brief "price list of instruments described herein made or sold by the author at Great Turnstile, Holborn, London, W. C."; but as a matter of fact the list is a useful addition, and is confined to one line for each instrument, in which is also given a reference to the page where the instrument is described. We detect no purpose anywhere to glorify the author's own manufactures at the expense of others; had we done so we should not have spoken so well of the book, of which we are glad to be able to speak very highly.

—*Interstate Commerce Commission Proceedings.*—Relative rates on live hogs, live cattle and the dressed products of each. In this case John P. Squire & Co. brought complaint against the Michigan Central R. R. Co., the New York Central & Hudson River R. R. Co. and the Boston & Albany R. R. Co., charging them with violating Section III of the act to regulate commerce by reducing rates on dressed beef and hog products without making a proportionate reduction for live hogs and cattle. The Commission held the claim valid.—Jacob Shamburg *vs.* D., L. & W. R. R. Co., and N. Y., C. & St. L. R. R. Co. In this case the complainant brought the charge of unjust discrimination. It was found that a firm of cattle dealers doing business in New York City, which procured its cattle on a large scale from Chicago and other Western points, had made an arrangement under the name of an express company of its own creation whereby it agreed to furnish a certain number of live-stock cars for the transportation of cattle. Also that above railway companies paid for the use of these cars a mileage of ¾ cent per mile, granted them especial facilities for making a large mileage, paid for their loading at Chicago, and paid a yardage of 3½ cents per 100 lbs. for yardage in the firm's own yards after delivery. It was held that this was an unlawful preference to the firm, and the Commission ordered the roads named to desist from paying such mileage and yardage.

—*Annual Report of the Board of Health of New Jersey, and Report of the Bureau of Vital Statistics, for* 1890. E. M. Hunt, Trenton, Secretary. Pamph., pp. 395, including index and map.

Aside from the reports of local health boards and the mortuary statistics, the annual reports of several of the state boards of health contain papers, often by prominent engineers, on various sanitary topics. The report under review contains the following papers of the above nature: "The Sewerage and Drainage of Trenton, N. J.," with map, by Rudolph Hering; "The Sewerage of Mt. Holly N. J.," by G. E. Gaskell; "The Deterioration of Water in Reservoirs and Conduits. Its Consequences and Modes of Prevention," by C. B. Brush; "Further Consideration of Water in Reservoirs and Conduits," by G. W. Rafter;

"The Relation of Ground Water to the Health of a Community," by G. E. WARING.

The report of Secretary HUNT touches upon various sanitary topics, and the volume gives in detail circulars issued to health inspectors of the state as guides in making inspections. An abstract of the papers and discussions of the New Jersey Sanitary Association, 1890, by D. C. ENGLISH, is included.

—*Annual Report of the City Engineer of Boston for 1890.* ANDREW JACKSON, City Engineer. Pamph., pp. 134, diagram and illustrations.

The work of the Boston Engineering Department, as stated and reviewed in this report, consists of an examination and supervision of structural repairs of bridges, designing and superintending the construction of new bridges, retaining walls, city wharves, etc., and miscellaneous engineering work; charge of the engineering work in connection with the water-works, improved sewerage or main drainage and parks.

One of the illustrations show a cross-section of a proposed iron bridge over Ferdinand St., the contracts for which have been awarded. The other illustrations are views of dam No. 5, Sudbury River additional water supply, and the diagrams relate to rainfall and the daily consumption of city water. These latter illustrations and diagrams, together with the supplementary tables and text relating to water-works were noted in the review of the report of the Boston Water Board in ENGINEERING NEWS for March 28.

For those who are so fortunate as to have a file of the Boston Engineering Department Reports from 1868 to 1890, the index to the same, which forms an appendix to the present issue, will be of value.

—*Geological Survey of Kentucky: Report on the Geology of Whitley County and a Part of Pulaski;* by A. R. CRUNDALL, Frankfort. Paper, 8vo; pp. 41, with map and ten excellent engravings.

A curious omission has been made in this report. There is not a hint anywhere as to its date or the date of publication. We suppose it to be 1890; but anyone picking up the volume a score of years hence would have much difficulty in determining its age. The report is an admirable one, devoted principally to a description of the coal deposits in the section covered. The seams are very numerous, though none of them are very thick. Quite a number, however, are being worked and are producing coal of fine quality.

—*Geological Survey of Kentucky: Report on the Geology of Clinton County.* By R. H. LOUGHRIDGE, Ph.D., Frankfort. Paper, 8vo; pp. 48, with map.

This volume is less interesting than the preceding, as the mineral deposits are confined to a small area of coal lands. The work of the Kentucky survey, under the direction of Prof. JOHN R. PROCTOR, is being very thoroughly done and in view of the extensive mineral wealth of eastern Kentucky, it will doubtless abundantly repay the state for the amount expended upon it.

—*New York Railroad Club Proceedings.* Published by the Club. 4½ × 7 ins., pp. 40.

Four of the papers read at recent meetings have been printed by the club in a small pamphlet. The papers are: "The Best Diameter for Car Wheels," "Recent Improvements in Car Wheels," "Prospects of the Use of Aluminum in Railroad Work" and "Pressed Steel in Car Construction." All these have been abstracted in recent issues of ENGINEERING NEWS. Copies may be obtained of the Secretary, 73 Broadway.

—*The Corliss Engine.* By JNO. T. HENTHORN. *Management of the Corliss Engine.* By CHAS. D. THURBER. In one volume. New York, 1891. Egbert P. Watson & Son. Cloth, 5 × 6½ ins., pp. 92; 22 cuts. $1.

This little volume seems to be intended for stationary engineers. It describes the methods of setting up and operating mill engines of the Corliss type. The price of the book is excessive, considering the small amount of matter it contains. The whole of it would not cover a dozen pages of ENGINEERING NEWS.

## TRADE PUBLICATIONS.

—*Railway Specialties.* Catalogue of the Q. & C. Co., Chicago, Ill.; paper, 9⅛ × 7 ins.; pp. 24; illustrated.

This catalogue contains illustrations and particulars of the company's specialties in car doors and ventilators, Keystone car replacer, Servis tie plate, Davies spike, brake adjuster, etc.

—*Ames Plow Co.* Boston and New York. Catalogue of Farming Implements and Machines. 8vo., pamph., pp. 98.

This catalogue, in addition to an immense variety of agricultural tools of all kinds, includes most of the standard tools and articles of contractor's plant, as also horse powers and other minor tools of the kind bought by railway and other corporations.

—*Steam Pumping Machinery.* Dean Bros.' steam pump works. Indianapolis, Ind.; catalogue No. 17, 1891; paper, 6 by 7¼ ins.; p. p. 88; illustrated.

A neat and well-printed catalogue of pumping plant of all kinds, with details of pumps and valve gear; tables of dimensions, capacities and sizes; and some pages of general information. Hydrants, air compressers, etc., are also included in the catalogue.

—*Railway Equipment.*—Catalogue No. 14; A. S. Males & Co., Cincinnati, O.; paper, 3¼ × 5¾ ins., 28 pp.

Catalogue of locomotives, dummy engines, cars, bridges, shovels, snow plows, etc., for sale, with descriptions of same.

—*Steam Cranes.*—Grafton & Co., Bedford, England. Pamph., pp. 12.

The machines illustrated in this catalogue are nearly all of them mounted on trucks, and by a simple arrangement of bevel gears are self-propelling. This type of crane is too little known in this country; and it would seem as if the great saving by their use might be made here, where wages for common laborers are so high.

## SOCIETY PROCEEDINGS.

**Western Railway Club.**—At the meeting on April 21 the discussion of amendments to the Rules of Interchange was concluded. Some notes on the interchange of freight cars in Chicago were presented by Mr. P. H. Peck and are reprinted elsewhere.

The discussion of Mr. Hickey's paper on "Locomotive Boiler Construction" (reprinted in ENGINEERING NEWS, April 4) then began. Messrs. W. H. Lewis and C. F. Lake had had some trouble with cracked side sheets in steel fire-boxes and had tried best quality of iron for side sheets; but it would begin to crack after about a year, so they returned to steel. Mr Forsyth said that the cracking of these plates was due to the fact that under the high temperature of the fire-box the sheets absorb carbon; iron is gradually changed to steel and soft steel gradually becomes hard steel. He had recently made tests showing that a steel plate which had but 50,000 to 55,000 lbs. tensile strength when put into the fire-box, had its tensile strength increased nearly 10,000 lbs. and the ductility reduced after being in service for some time.

Other points brought out by the discussion were, that it is better to machine the mid ring so as to get a good joint with the side plate than to put a double row of rivets there. The longitudinal tie-rods directly above the crown sheet were also objected to. The radial stays of Mr. Hickey's design were commented on by several members as an excellent detail.

At the next meeting, on May 21, the subjects for discussion will be "Air Brakes in Interchange," and "Car Heating."

**Engineers' Club of Philadelphia.**—At the meeting on April 18 Mr. John C. Trautwine, Jr., presented for Captain S. C. McCorkle an illustrated paper on "Land-Locked Navigation from Long Island Sound to the Mississippi River." The author has simply given that portion of the route from the Suwanee River to the Mississippi, with which he is most familiar, leaving to the United States and civil engineers the Florida Ship Canal, which is the key to the whole project. The portion of the route referred to between West Florida and Louisiana has for its initial point the Suwanee River. The exact point of departure depends upon the location of the Florida Ship Canal. It is variously estimated that the distance from the Suwanee River to St. Marks is from 70 to 90 miles, the former referring to a direct cut and the latter to a dredged line. From St. Marks to the Mississippi there is a water line nearly all the way, but requiring improvement. The Oclockony and Crooked rivers require straightening and the removal of sundry bars, which is not supposed to be difficult and entirely practicable. In St. George's Sound, near Apalachicola, an oyster bar needs to be removed, and then the Apalachicola River is reached with 12 ft. of water on the bar. The distance from St. Marks, Fla., to Apalachicola, Fla., by the coast line, is about 61 miles; by the Oclockony and Crooked rivers about 10 miles longer. From the Apalachicola River to the Mississippi the distance is about 400 miles, and it will require about 30 miles, possibly less, of canaling to make land locked connection between the two rivers. No attempt has been made to solve engineering difficulties or to make estimates, the route is given and the data furnished for some ambitious engineer to give to the country one of its most important means of coast defense and to add to the commercial facilities of the whole country. Estimated total distance from the Suwanee to the Mississippi, 500 miles. Estimated depth of water, 9 to 12 ft. at mean low water.

HOWARD MURPHY, Secretary.

**Southern & Southwestern Ry. Club.**—At the meeting at Memphis on March 19 the subject of vertical plane couplers was discussed by Pulaski Leeds, Superintendent of Motive Power of the Louisville & Nashville R. R. He expressed himself in favor of the universal adoption of the M. C. B. coupler, and thought the change from the link-and-pin to the present style should be made as rapidly as possible. As long as the M. C. B. couplers are in use on a portion only of the cars the expense of maintenance will be greatly increased, and the danger of handling the cars will be increased by the couplings made between link-and-pin cars and cars with the M. C. B. drawbar. Breakages are especially likely to occur if the link is removed from the M. C. B. coupler and it is coupled to a common drawhead. The M. C. B. coupler is designed to withstand shocks only when the knuckle is in, and without them it is at the mercy of any form of drawbar. Knuckles should always be replaced, therefore, as soon as broken. If this cannot be done, a common drawbar should be substituted.

The M. C. B. coupler should be improved by making it automatic in opening as well as in closing, and by making the unlocking levers move by a motion across the end of the car instead of by a fore-and-aft motion as at present, to secure greater safety to the trainmen. Some provision should also be made for preventing a drawbar from falling upon the track if pulled out, and thus causing derailment.

At the meeting of the club on April 16 at St. Louis a paper on "Locomotive Rods" was read by W. J. Hemphill, Superintendent of Motive Power of the Jacksonville Southeastern Ry. He favored the use of iron rods of rectangular section for the main rods, with the I section for parallel rods. On the main rod he favored a solid front end and a strap connection on the rear end. After trying solid-ended parallel rods, and those with strap, bolts and keys, he was strongly in favor of the solid end. It is cheaper both in first cost and cost of maintenance, and he had not yet heard a report of a solid end being broken. On the other hand, injudicious keying makes breakages of the strap-end rod very common. It is sometimes objected that solid end rods rattle; but this has been found to occur only where there is a collar interposed on the pin between the main and the parallel rod. If this collar is dispensed with, there will be little or no rattling. The best method of securing the bushing in the solid end is to screw a dowel through the top, which may be also used to hold the oilcup.

**American Society of Civil Engineers.**—The regular meeting was held May 6, President Octave Chanute in the chair.

A paper by Mr. Julien A. Hall on "Right of Way for Railways" was read by the Secretary. The paper called attention to the fact that this important department of railway work does not always receive the attention it merits, with the result that the company may eventually suffer from litigation over the title to the land. It was recommended that the right of way should be secured by and the deeds put in proper shape by an engineer who has good business judgment as well as engineering knowledge, and who should report to the chief engineer. The deeds should be copied in the office of the chief engineer and the right of way maps completed by their aid. It was especially recommended that everything connected with right of way should be kept out of lawyers' hands as far as possible. The maps should be on a scale of 200 ft. to 1 in., made on tracing cloth in mile sections, and blue print copies may be made for the court.

In the discussion Mr. R. L. Harris emphasized the advantages of having this department under the charge of the chief engineer. He referred to several cases that had come within his own experience in connection with right of way work. Mr. C. B. Brush thought it very important that the engineer should not go too far beyond his own line of work, and should consult with a thoroughly competent lawyer on all land questions. He did not approve of blue prints as permanent records, as they will fade. Mr. J. F. Crowell agreed with Mr. Brush that legal knowledge and advice are absolutely necessary. The chief engineer should have the decision of what land is needed, and have the means of acquiring the same under his control. The right of way agents should not be allowed too much latitude. Large railway companies usually have a real estate department, as the chief engineer could not attend to it and to his other duties. Mr. E. P. North thought the lawyers on such cases should be employed by and report to the chief engineer. Mr. C. E. Emery and other speakers also referred to the necessity of having competent legal advice in right-of-way matters, especially as the laws bearing on land purchase for railways, etc., vary in different sections. Mr. Brendlinger suggested that in view of the importance of and general interest in the subject, the paper should be brought up for discussion at the coming convention.

The following candidates were declared elected:

*Members.*—W. A. Allen, Chief Engineer, Maine Central R. R.; Edward Burr, U. S. Engineers, Cascade Locks, Ore.; George D. FitzHugh, Consulting Engineer, Louisville & Nashville R. R., Birmingham, Ala.; Charles W. Gay, City Engineer, Lynn, Mass.; Robert Giles, Locating Engineer, A. T. & S. F. R. R.; Howard H. Jackman, City Engineer, Wichita, Kan.; Andrew D. Whitton, Chief Engineer, Philadelphia Traction Co.

*Associate Members.*—F. C. H. Arentz, of Mickles & Arentz, contracting engineers, St. Louis, Mo.; W. A. Cattell, Assistant Chief Engineer, Long Island R. R.; Harry Frease, Chief Engineer, Valley Ry.; Thomas H. Grant, Assistant Engineer of Maintenance of Way, Philadelphia & Reading R. R.; Wm. D. Janney, Division Engineer, Norfolk & Western R. R.; Richard Lamb, Consulting Engineer, Norfolk, Va.; Fred Morley, Michigan University; T. Starrett, Chicago, Ill.; E. C. Stout, New York, N. Y.; Geo. C. Urquhart, Assistant Engineer of Maintenance of Way, Pittsburg, Cincinnati & St. Louis Ry.; Sigmund von Gemmingen, Richmond, Va.; Edwin H. Warner, Seattle, Wash.

*Associate.*—Harry Comer, Jersey City, N. J. *Juniors:* James Berrall, Biltmore, N. C.; E. T. McConnell, Indianapolis, Ind.; J. C. McGuire, Phœnixville, Pa.; Wm. C. Tucker, New York, N. Y.; F. W. Wilson, Cleveland, O.

# ENGINEERING NEWS

AND

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## COMING TECHNICAL MEETINGS.

***Engineers' Club of Kansas City.***—May 11. Rooms, Baird Building. Secy., H. Goldmark.

***Denver Society of Civil Engineers.***—May 12, "Electric and Cable Railways in Denver." Secy., Geo. H. Angell.

***Civil Engineers' Club of Cleveland.***—May 12. Secy., A. H. Porter, 50 Euclid Ave.

***Civil Engineers' Association of Kansas.***—May 13. Secy., J. C. Herring, Wichita, Kan.

***New England Railroad Club.***—May 13, "Rules for Interchange of Freight Cars." Secy., F. M. Curtis.

***Engineering Association of the South.***—May 15, at Earlington, Ky. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

***Northwestern Track and Bridge Association.***—May 15. Secy., D. W. Meeker, St. Paul, Minn.

***Engineers' Club of Philadelphia.***—May 16. Secy., Howard Murphy, 1122 Girard St.

***Engineers' Society of Western Pennsylvania.***—May 19. Secy., J. H. Harlow, Pittsburg, Pa.

***Engineers' Club of St. Louis.***—May 20. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.

***Boston Society of Civil Engineers.***—May 20. Secy., S. E. Tinkham.

***Western Railway Club.***—May 21. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery Bldg.

***Engineers' Club of Cincinnati.***—May 21. Secy., J. F. Wilson.

***New York Railroad Club.***—May 21. Rooms, Gilsey House. Secy., H. G. Prout.

***American Society of Civil Engineers.***—Annual meeting, May 21, at Lookout Mt., Tenn. Secy., Francis Collingwood, 127 E. 23d St., New York.

***Civil Engineers' Society of St. Paul.***—June 1. Secy., C. L. Annan.

***Western Society of Engineers.***—June 3. Secy., J. W. Weston, 280 La Salle St., Chicago.

***Engineers' Club of Minneapolis.***—June 4. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

***Technical Society of the Pacific Coast.***—June 5. Secy., O. von Geldern, 819 Market St., San Francisco.

***Association of Civil Engineers of Dallas.***—June 5. Secy., E. K. Smoot, 803 Commerce St.

***Northwest Railroad Club.***—June 6. Secy., H. P. Robinson, St. Paul, Minn.

A GENERAL INDEX TO ENGINEERING NEWS, extending from the first issue of Volume I, in 1874, to the end of Volume XXIV (July–December, 1890), is issued this week in a separate small volume handsomely bound in cloth, which will be sold at $1. It will prove a valuable work of reference even for those whose files are not complete.

THE approaching convention of the American Society of Civil Engineers at "Look Out Inn," as it is modestly termed, on the top of Lookout Mountain, Ga., bids fair to be an especially pleasant and successful occasion, and every member who can will do well to attend it. In the first place (to mention first what is apt to interest members least on these occasions) the quantity and quality of papers read bids fair to be above the average, and advance proofs of a number of these papers can now be obtained for discussion. In the second place, the location of the convention is of exceptional technical interest, on account of the great development of the iron industry which is going on all around it, and which in the opinion of the best judges is destined in the near future to make the southern iron district in which Chattanooga lies the greatest iron district of the world, producing perhaps more iron than all the rest of the world put together. In the third place, the district is historically one of the most interesting in the country, the whole vast area where the tactical maneuvers and battles took place in the vicinity of Chattanooga being visible from the hotel or surrounding grounds. Last, but not least, the "inn" is one of the finest, most beautifully located, and most perfectly appointed hotels in the country, and commands a view (or rather several different views) of unsurpassed grandeur and beauty. Though located some 2,000 ft. above Chattanooga, it is only 4 miles from it; it is made accessible by three different lines of railway, a cable railway (ENG. NEWS, Jan. 7, 1888), rising 1,760 ft. in 4,360 ft., with a narrow-gage extension 2 miles long to the Inn, a standard-gage road on a continuous 1½ per cent. grade (ENG. NEWS, Nov. 1, 1890), running direct to the hotel in about an hour, and a new and remarkable cable railway also running direct to the Inn, with 14 to 80 per cent. grades (ENG. NEWS, March 28, 1891), of which Mr. FRANK C. ROBERTS, of Philadelphia, is Chief Engineer, and of which we shall hereafter give further description. Taken all in all, the Society has not for years chosen so delightful a spot for its convention, and its attractions are already evident in the long list of men who have announced their intention to attend.

A VALUABLE feature of the Boston city engineer's reports, for some years past, has been an index to the Engineering Department Reports of that city from 1868 to, but not including, the year of issue, the latter year always being separately indexed. The value of such an index, especially to the department, is obvious, but such features are rare, to say the least. When one sees such books as "The Autocrat of the Breakfast Table" and "Over the Teacups" indexed, and finds the indexes handy, it seems strange that so many works of reference, especially when prepared by busy men for their own as well as others' use, should have a poor index or none at all. It is practically impossible to publish a yearly general index to monthly or weekly periodicals, but quite easy to do so for a yearly publication. The action of Boston is commendable and might well be followed by other cities. A general index, once in five years even, would be a great help, and is practicable for city reports, society proceedings and many monthly and weekly journals. The recently-issued general index to the publications of the American Society of Civil Engineers has already proved itself of great usefulness, and doubtless the forthcoming general index to ENGINEERING NEWS will be even more convenient, owing to the far greater number and range of references which it will contain.

THE Census Bulletin on Education (No. 53, relating wholly to common school education, and only covering 35 states) tends somewhat to support the general accuracy of the census which we and others have questioned. As will be seen from the table in another column, the 17 Northern States reported show an average increase of 21.02 per cent. in population and 13.47 per cent. increase in school enrollment, every one of the states, except Rhode Island, Delaware, Maryland and the District of Columbia, showing a sensibly smaller increase in school enrollment than in total population. This latter fact is easily accounted for by the large emigration to this section, which does not bring with it corresponding school enrollment; and making allowance for this, the two percentages compare pretty well, but, on the other hand, *do not* indicate any considerable change in the birth rate since the last census, which is required to make the 1890 census figures hold together at all. It is to be remembered that there is a large emigration from the North to the South and extreme West, tending to decrease its percentages of increase. There has been no such change in school facilities in the North as to bring about of itself any material change in the percentage of school attendants to the total population.

On the other hand, the South shows an enormous advance in school enrollment, averaging 63.51 per cent. against 22.25 per cent. increase of population, a change due to the great increase in school expenditures and facilities, while the extreme West shows still more phenomenal growth in both population and school attendance. The showing as a whole is a very pleasing one, indicating that good facilities for elementary education are being liberally provided for in all states by voluntary action of the people, and that there is no noticeable difference in present policy or interest in any of the states and territories, which all alike are aiming toward ample educational facilities.

Mr. WILLIAM F. SHUNK, who has just left this country to take charge of the surveys for one section of the proposed Intercontinental Railway, as our readers have been previously advised, writes us that simultaneously with his appointment he was "gripped" by the fashionable malady, and it was only by imprudent effort that he could attend to the necessary preliminaries of his departure. Consequently, he was quite unable to answer the numerous letters addressed to him at that time, whether of a friendly or business nature, and he requests us to "kindly frame an apology for publication in ENGINEERING NEWS, thanking all my correspondents, both those who wrote for themselves and those who wrote for others. They placed me under obligation and I regret having been forced into the discourtesy of stockish silence on such an occasion, for the first time in my life."

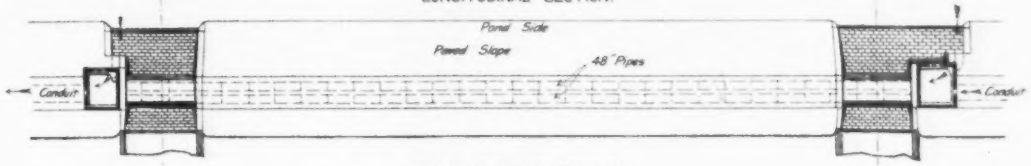
While no one who knows Mr. SHUNK will deem any apology necessary, to those who do not, this explanation may be welcome.

THE following letter from Mr. D. McN. STAUFFER, giving some preliminary information as to his observations and experience in Nicaragua, will be read with interest:

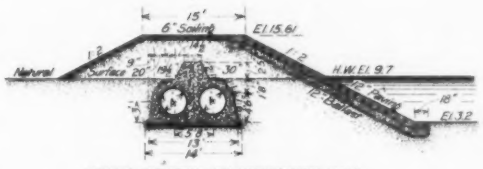
> We reached Managua [the capital of Nicaragua] April 16, and attended a reception by the President on that evening. Things move very slowly here, provokingly so, in traveling and everytoing else. I have gathered many interesting notes of the canal and have changed my mind as to the "unhealthy" features of this country. As the best evidence, a party of about 20 tenderfeet have passed about a week in the jungle; it rained every day; we wore almost constantly wet, we slept in the shacks, fed with provisions carried by packers; we climbed slippery hills through the whole day; and yet not a single individual was in any way affected by the exertion or exposure. Of animals we saw but few, and these were monkeys, and I killed the only deadly snake seen—a small "tobaba." I find the rock on the divide cut ALL basalt, of varying types, and of a good working character. Have also studied the dams, etc.
>
> We shall be here for several days yet and then go to Rivas and the west end of the canal by May 12. Our wreck upset the previous schedule, I am sorry to say, as I am anxious to get to civilization again. We have been roughing it with a vengeance, and for a week we were in mud up to our eyes. Since then we have been carrying our beds with us and putting up as best we may. It has not been a picnic exactly.

Mr. STAUFFER brings back with him very full records as to the character of the material, rainfall, temperature, etc., as well as the results of his own personal observations, and our readers may

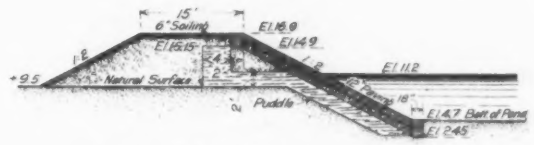
LONGITUDINAL SECTION.



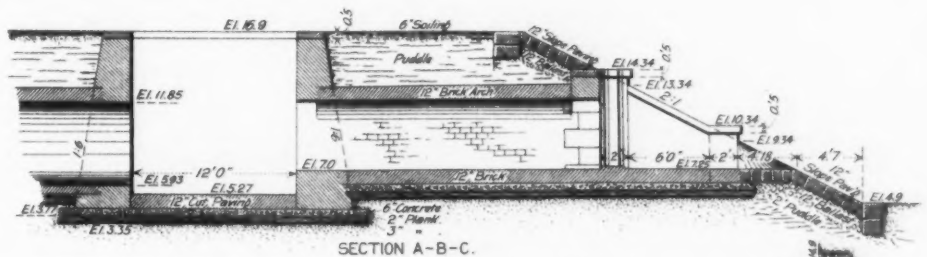

PLAN OF RIDGEWOOD DAM.



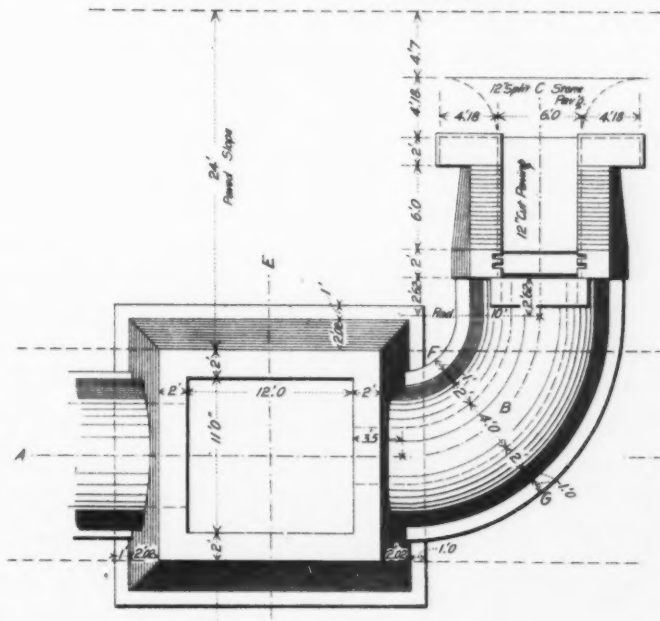

CROSS SECTION OF RIDGEWOOD DAM.



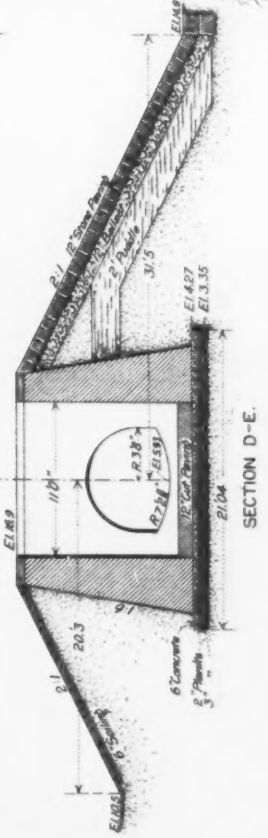

CROSS SECTION OF MASSAPEQUA DAM.



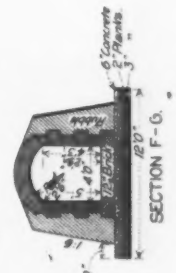

SECTION A-B-C.



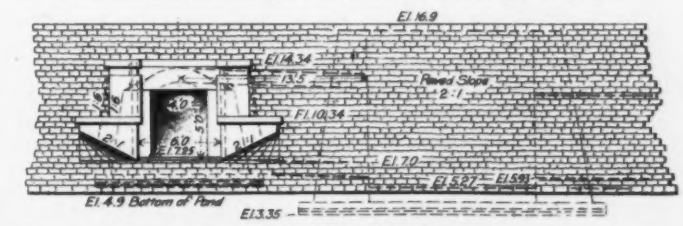

PLAN.




SECTION D-E.

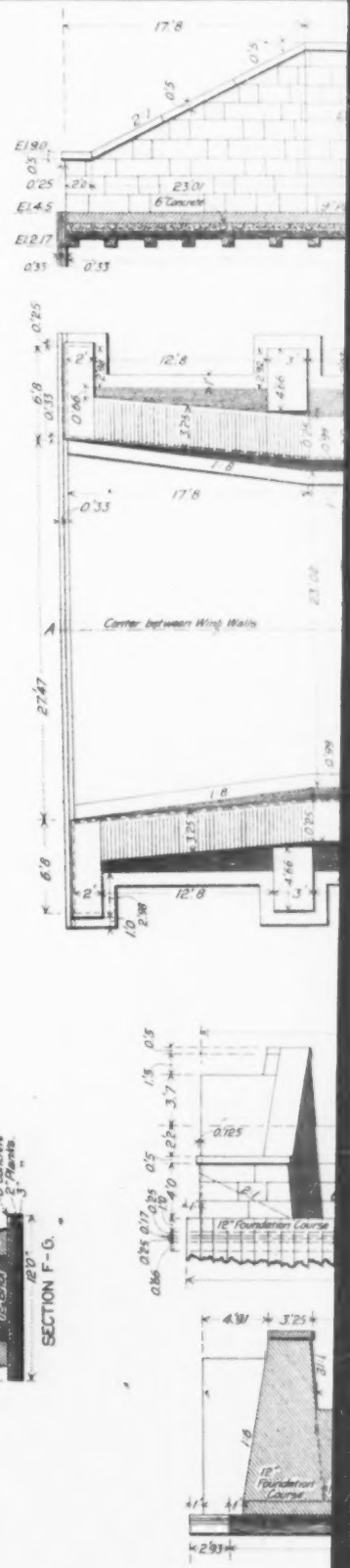



SECTION F-G.




NORTH ELEVATION.

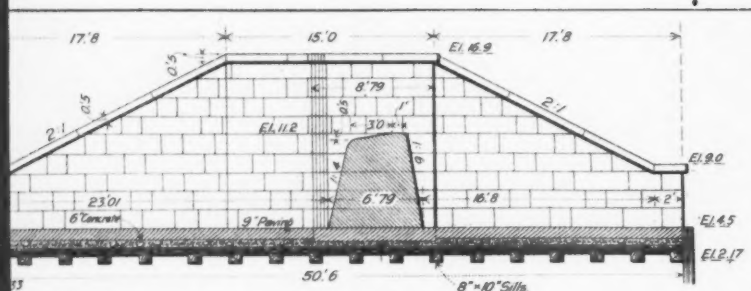
GATE HOUSE AND INLET AT MASSAPEQUA POND.



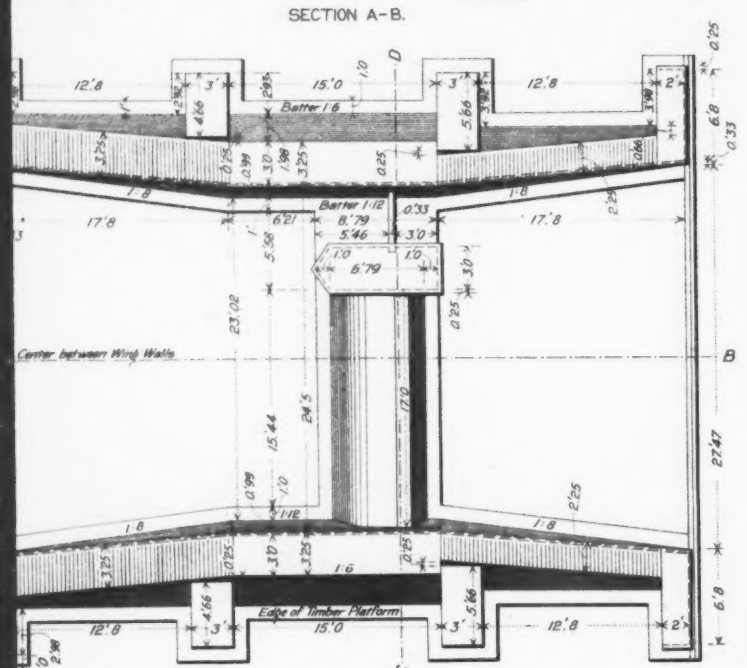

THE BROOKLYN W

ROBERT VAN BUREN, CHIEF ENGINEER.

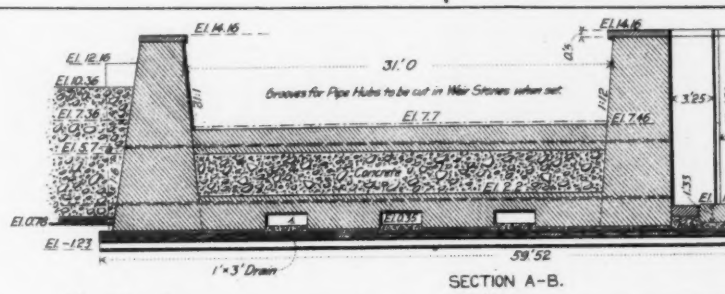
JOHN P. ADAMS



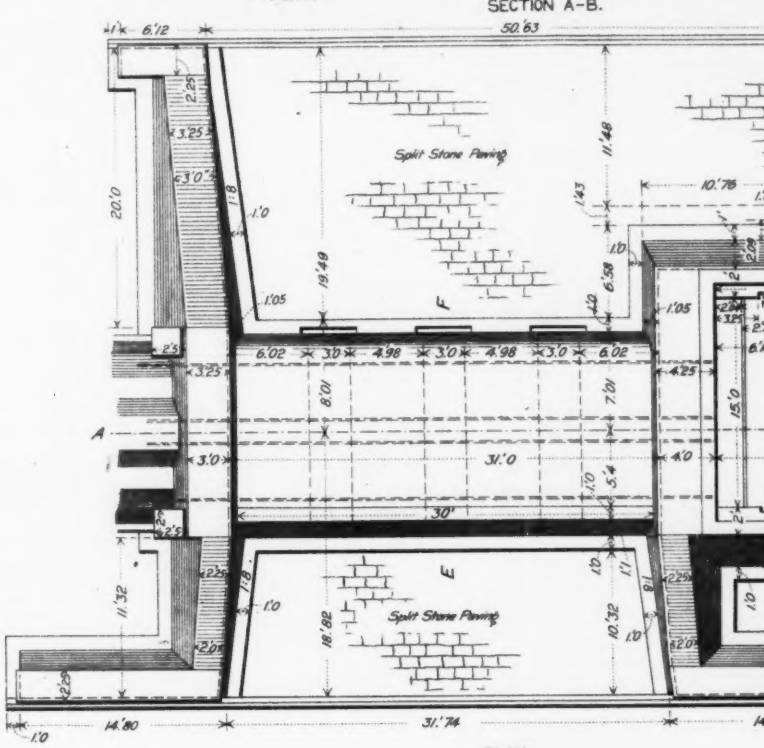

SECTION A-B.



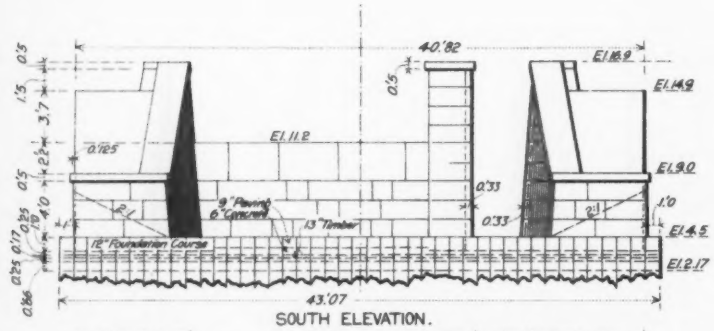

PLAN.



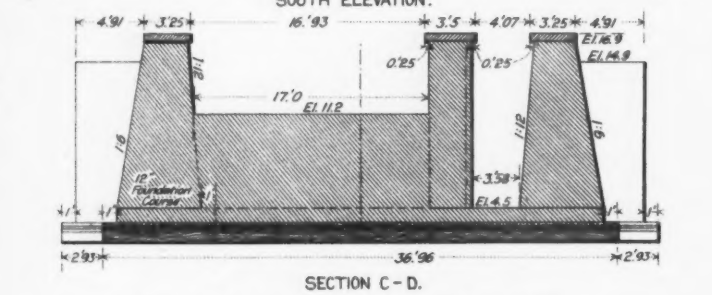

SECTION A-B.




PLAN.

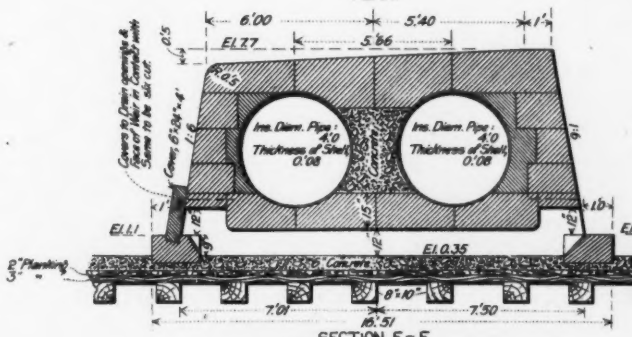



SOUTH ELEVATION.

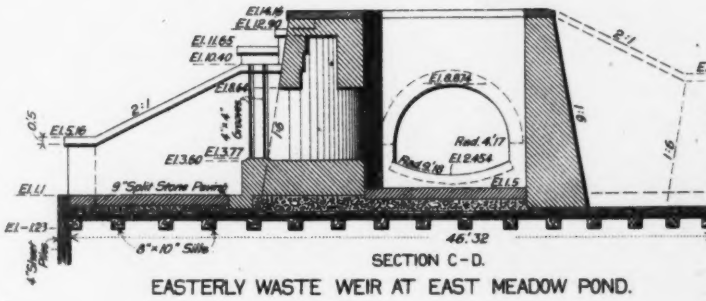



SECTION C-D.

WASTE WEIR AT MASSAPEQUA SUPPLY POND.




SECTION E-F.
(DOUBLE SCALE OF PLAN.)



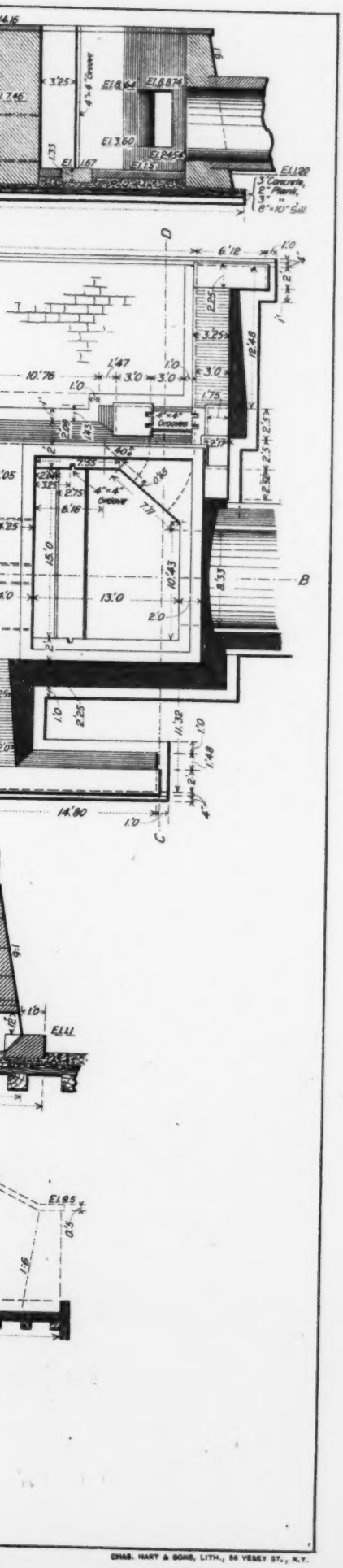

SECTION C-D.

EASTERLY WASTE WEIR AT EAST MEADOW POND.

# BROOKLYN WATER-WORKS EXTENSION.

N, CHIEF ENGINEER. . I. M. DE VARONA, ASSISTANT ENGINEER IN CHARGE.

JOHN P. ADAMS, COMMISSIONER OF CITY WORKS.




CHAS. HART & SONS, LITH., 58 VESEY ST., N.Y.

look forward to seeing shortly in these columns a plain, unvarnished record of the results of actual observations along the line of the canal, from a pretty keen, and, we venture to add, particularly well-qualified observer, who is anxious only to show the facts as they are.

### Experiments with the Ries Electric Traction-Increaser on Locomotives.

In our issue of Aug. 9, 1890, we illustrated and described the system of increasing the tractive power of locomotives invented by Mr. ELIAS E. RIES, of Baltimore, Md. The system consists in passing a current of electricity of great quantity but low voltage from the driving-wheels of the locomotive to the rail. The passage of this current is claimed to cause an "incipient welding" of the wheel to the rail, and to thus increase the coefficient of sliding friction between the two, without increasing the rolling friction.

As we stated in our former article an effective and practical traction increaser which did not also increase the rolling friction or the weight on the driving-wheels would be an improvement of great value to the locomotive. We therefore described Mr. RIES' invention, believing from the experiments made by other electricians that there was some chance at least of making it a practical success. We have now before us a pamphlet headed "Report of the Consulting Electrician to the President and Directors of the Ries Electric Traction and Brake Co." This report is stated to be put forth in part at least to induce subscriptions to 3,000 shares of the company's stock. The "Consulting Electrician" to the company proves to be Mr. RIES himself. As he is the sole inventor of the devices controlled by the company, and is moreover prominent in its management, and doubtless the holder of a considerable portion of its stock, a report from him as "Consulting Electrician" to influence prospective investors may seem a little incongruous. However, as Mr. RIES is a member in good standing of the American Society of Electrical Engineers, he ought to be a competent adviser and able to waive personal interests in reporting upon the progress and prospects of the company.

In accordance with a written permission from Mr. RIES to "publish such extracts as we may see fit from this report," we abstract the following:

The first practical test of the system was made in 1889. On a Philadelphia & Reading 60-ton consolidation locomotive was mounted a 6,000-watt (equals 8 electrical H.P.) direct-current dynamo, driven by a Brotherhood engine. This locomotive was tested on the Frackville grade of the Philadelphia & Reading R. R., which has an average rise of 185 ft. per mile for 7 miles. In one case the locomotive hauled a train of 47 coal cars up this grade in 29 minutes with the aid of the traction increaser, when without it 55 minutes were required to haul the same load. It is also stated that the fuel used was much less in the former case.

No further statement is made of the results attained in these tests, except that they "were so satisfactory that it was decided to continue the experiments at once with a new and somewhat larger electrical equipment." Arrangements for these tests were made with the Baltimore & Ohio R. R. Co., and a 53,000-lb., 4-driver passenger locomotive was selected for equipment.

A new alternating-current dynamo of 60,000 watts capacity (*or no less than* 80 *electrical HP.*) was designed and mounted on the same bed plate with a Brotherhood engine, and this was put in place on the locomotive. After some delays and difficulties the apparatus was got into working order in the early part of this year, and tests showed about 10% increase in traction by the use of the current. We quote from the report as follows:

> This showing, however, while to a certain extent satisfactory, was not quite up to that which was expected from a dynamo of this capacity, and a series of careful measurements were entered into to determine the cause of the comparatively low efficiency. It was soon discovered on measuring the electromotive force and current that, instead of 60 kilowatts [60,000 watts], the machine gave but 20 kilowatts [20,000 watts], or not more than one-third of its output, when running at full speed. This lack of power was found to be due partly to slight defects in the construction of the dynamo and partly to the extra resistance introduced into the traction circuit by the switch and brush connections used in this particular equipment, but which in regular practice will be entirely dispensed with.

Experiments were also made with a small model, and from these it was concluded that the substitution of an alternating-current machine for the direct-current machine was a great mistake, and that the direct-current is nearly twice as effective in increasing traction as the alternating current.

Since three times two are six, Mr. RIES concludes that "a direct-current dynamo of 60,000 watts [80 E. HP.] capacity should give a tractive adhesion *nearly six times as great*" as that obtained from the alternating-current dynamo just tested.

Mr. RIES concludes his report with a roseate estimate of the future profits of the company based on the following:

> It is estimated by competent authority that an increase of only 25% in the tractive adhesion of locomotives, which should be readily attainable by this system, is equivalent to an increase of from $25 to $50 per day in the earning capacity of railroads for every locomotive so equipped.

On this basis he thinks that $5 per day per locomotive would not be an excessive royalty to charge railway companies for the use of the apparatus, and "as there are at the present time nearly 40,000 steam locomotives in the United States" [Poor gives 31,062 in his last volume], if only one-tenth of this number were equipped by the Ries Electrical Traction Co., it would bring "the handsome revenue of $20,000 per day."

Or suppose that the company permits the railways to use its invention for the nominal sum of $1 per day per locomotive equipped. Then, if only half the locomotives in service are equipped, the company will still have an income of $5,000,000 a year, while the net saving to the railways by the use of the device "will equal the enormous sum of $125,000,000 to $250,000,000 yearly!"

Criticism of these sanguine or more than sanguine estimates of the future profits from this invention may be very brief. Mr. RIES was evidently not writing for men familiar with railway affairs. As the entire cost of operation of the railways of the country was only $674,731,517 in 1889, or an average per locomotive in service of $21,765 for the year, or about $72 per day, it is a little difficult to see how the use of a traction increaser of any degree of perfection could "be worth $25 to $50 per day to the railway companies."

But more serious faults in the report than exaggeration of financial prospects are to be found. At the time we published our former description of the Ries apparatus, a 6,000-watt dynamo was used, requiring, probably, something over 10 HP. to drive it. In the present equipment a 60,000-watt dynamo has been used, which, when run at its full capacity, generates $\frac{60000}{746} = 80$ electrical HP. Probably it would require a Brotherhood engine of not less than 100 HP. to drive this dynamo to its full capacity. That it is intended to use this full capacity in service is admitted by Mr. RIES, in the extract quoted above, for the experiments showed unsatisfactory results with an electrical current of 20,000 watts, or about 27 HP., and he expressly states that the new direct-current dynamo (which is to be built as soon as stock enough can be sold to raise the money) is to be of such capacity as to be run by the engine used for the alternating machine, which we must suppose was large enough to run that to its full capacity.

In our former article on this invention we said: "Whether an effect in increasing traction great enough to be of value can be obtained with ordinary locomotives without the use of too heavy machinery and the use of too much power remains to be seen." Mr. RIES seems to think that a 100 HP. engine and a 60,000-watt dynamo are not too large to mount upon a locomotive for the purpose of increasing traction. Railway men may have a different opinion.

The weight of this little attachment is not stated in the report; but it would probably be enough to account for a good part at least of the 10% increase in tractive power claimed to have been obtained.

Concerning the important question of the steam consumed by the traction-increasing plant, however, Mr. RIES gives the following particulars:

> It should be stated here as a remarkable and important fact that in none of the running or standing tests of the apparatus subsequently made was the consumption of steam by the 3-cylinder engine noticeable upon the steam gage of the locomotive boiler, which normally registered a working pressure of 140 lbs. per sq. in. On one occasion the dynamo was purposely "short-circuited" and run at its full capacity for half an hour while the locomotive stood in the round-house, with its fires banked at a boiler pressure of 80 lbs., without any material fluctuation or change being perceptible upon the gage.

It is for this paragraph that the writer seems to deserve the severest criticism, unless he can give some other explanation of its meaning than the apparent one. It says that the dynamo was run at its full capacity for half an hour while the locomotive stood in the round-house with fires banked. "Its full capacity" was 80 electrical HP., requiring at least 100 HP. of steam for the engine. We do not know what peculiar type of dynamo Mr. RIES has devised; but engineers generally will be glad to learn how it can run for half an hour, when short-circuited, generating electricity to its full capacity, without injury to itself or to the electrical connections. In short, it may be guessed that the "short-circuiting" was so done that the dynamo generated little or no electricity, and that the power absorbed was only that required to overcome the friction of the engine and dynamo. Under these circumstances it is not strange that the steam consumption was small, for the amount used was not by any means that required to run the dynamo to its full capacity, as Mr. RIES claims.

We feel the more at liberty to make the above extracts and comments because we have before this given the device a full and fair showing in the columns of ENGINEERING NEWS (Aug. 9, 1890), and some of our readers may have become interested in the device or may now wish to share in the future profits of "$5,000,000 per annum" which the "Consulting Electrician" foresees. Probably, however, the people who subscribe the money for the future experiments of the RIES Electric Traction Co. will be of that class who are not aware that only 746 watts of electrical energy are equivalent to 1 HP. of mechanical energy.

Of course, it is not certain that there may not yet prove to be something of practical value in the principle involved in Mr. RIES' invention. We make the above extracts and comments on his own published statements, and leave our readers to judge for themselves whether any results of value are likely to be reached from the experiments as at present conducted. As we stated in our former article, it seems to have been pretty well proved that in the case of small models, or even cars large enough to carry a person, when an electrical current passing from the wheel to the rail is of very low voltage and very great quantity, a considerable increase in the coefficient of friction does take place. Whether this can ever be applied to the locomotive without too much expense and weight in proportion to the gain remains to be seen. We throw out the hint for what it may be worth to those who wish to investigate this problem that the electric plant might possibly be a stationary

one, located at steep grades, from which each locomotive passing over the line would take a supply of electricity by means of a trolley or brush on a line wire, and use it for increasing the traction.

We have already stated that Mr. RIES is a member of the American Institute of Electrical Engineers. In justice to that society it should be said that its membership includes men who are experts in their profession, and possess a thorough technical training and experience, and a high sense of professional *esprit de corps*. These men we know to be most desirous of raising the professional standard of their society and making it more worthy of that public confidence which, as Mr. CLEMENS HERSCHEL has recently said, distinguishes the professions from the other vocations of life. But if they would achieve for the members of the institute that high standing in the engineering profession which they desire, such "professional work" by its members as that above described must meet the general condemnation of the society.

Professional incompetency due to ignorance, mistaken judgment, carelessness, or an oversanguine disposition are serious faults in an engineer, whatever his line of work; but there is an even worse offense than these which may be committed by an engineer in giving advice, and one which is a greater injury to the good name of the profession than any or all the rest.

Since the above was in type we have received a letter from Mr. RIES in which he says:

"Sixty thousand watts was the capacity for which the experimental dynamo was designed, on the rather safe principle of having a gallon when less than a pint would probably be required. . . . The results obtained show that with a direct current and the reduced resistance of the traction circuit provided for in the forthcoming tests, the total energy required will probably not exceed 10,000 watts, or about 13½ electrical HP., and even this may be greatly reduced in practice.

The best comment on this is Mr. RIES' published report, quoted above, which explicitly states that only about 10 per cent. increase of tractive power was obtained in the tests when a current of 20,000 watts (27 electrical HP.) was actually flowing; and he ascribes this practical failure to the fact that the dynamo was delivering but one-third its rated output. He recommends, also, that the tests be continued "with a direct-current dynamo of such capacity as to be readily operated by the 3-cylinder engine forming part of the present plant," which has an output of 80 electrical HP.

But more important than the size of the equipment which Mr. RIES hopes to experiment with next are the other features of the reports which are noted above. The question which the not too confiding investor in the stock of the Ries Company will ask is: How much confidence can be placed in the report of a "consulting electrician" who proposes to save from one-third to two-thirds the present cost of operating railways by increasing the adhesion of the locomotives one-fourth, and who shows the small steam consumption of an engine by running it unloaded for half an hour, stating at the same time that the dynamo to which the engine was attached "was run at its full capacity" when short circuited.

## CORRESPONDENCE.

### Standard Hatching for Drawing.

PHILADELPHIA, Pa., May 5, 1891

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Enclosed you will find copy of hatching, presumably a standard which has been adopted by Messrs. Cramps, of this city, and I think others doing government work. I am desirous of knowing if the U. S. government in its service recognizes this or any other as a standard hatching, or adheres to any standard in the execution of its own drawings? If such be in existence I am very anxious to secure a copy of the same, and shall feel myself under an obligation to you if you will vouchsafe any information or assistance bearing upon this matter, as I understand you have at one time interested yourself in the publication of a standard hatching.

HENRY A. GARDINER.

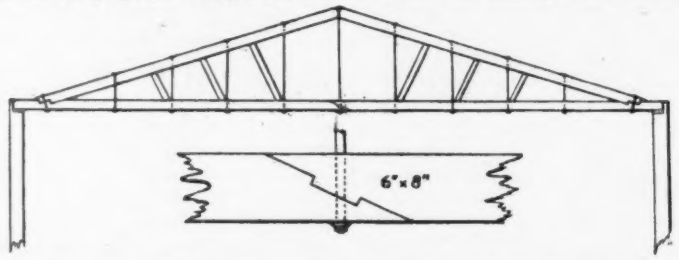
[In our issue of Dec. 31, 1887, we published the same set of standard hatchings which our correspondent incloses, which was then given as the standard of Cornell University. We also gave some differing proposed standards used at the Columbia School of Mines and elsewhere. We have no information as to what may be the present U. S. government standard, nor whether it has any common standard for its several departments, or for each of them separately; but we shall hope to obtain information after the publication of this letter. It is plainly desirable that there should be a well understood and generally accepted standard of conventional symbols.—ED. ENG. NEWS.]

### A Roof-Truss Failure.

TROY, Ala., April 30, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I inclose you a sketch of a wooden roof truss which was used here in the construction of the opera-house. The building was new, having been built early last winter. On April 29, at about 4:30 P. M., the trusses, without any warning, suddenly gave way, letting the roof fall in on the second floor, and pushing out the wall on the east side. The wall on the west side was badly sprung, but did not fall. There were at the time about 40 young people in the building, rehearsing for a musical entertainment. Two young ladies were killed outright, and several others were badly injured. The splices in the




ROOF TRUSS OF THE OPERA HOUSE AT TROY, ALA.; FAILED APRIL 29, 1891.

center of the tiebeams were stripped entirely apart in each case, showing the weak point in the truss. The portion of the roof directly over the stage did not give way, being somewhat supported by the stage mechanism. Fortunately, most of the people in the building were gathered on the stage at the time of the accident, which accounts for the small loss of life. Had the failure occurred in the evening the loss of life would have been fearful.

[Comment on the character of the work illustrated is certainly not needed. The moral pointed by the accident is the need of building-inspection laws in even the smaller cities, especially for all buildings intended for public assembly. When one considers the number of structures in the smaller cities and villages which are built entirely by rule of thumb, and which are often crowded to their utmost capacity, the wonder is that accidents through their failure are not more numerous. We believe there are few common carpenters, however, who would be guilty of making such an atrocious splice joint in a tie beam as that illustrated.—ED. ENG. NEWS.]

### Notes on English Railways.

LONDON, April 21, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have read with much pleasure your notes on English railways in ENGINEERING NEWS. On the whole you are, I think, very fair to us. As for the lighting of carriages, it is rapidly improving here. Electricity is becoming pretty common, and the Great Western Ry. has a new gas system which leaves nothing to be desired. Have you remembered to allow for the fact that with our compartment system the lighting must be made inaccessible to the passengers, so that your lamps would be inadmissible? I might add that I remember your paraffine lamps often smell disagreeably, and on the local trains outside Philadelphia on the Pennsylvania R. R. I found it quite impossible to read. As for what you say about the cross channel steamers, you must remember that they cannot be made larger if they are to get in and out of the tidal harbors; that to give them deck saloons would be unsafe in our stormy waters, and that in the fogs and mists of an English winter a steersman has hard enough work to do, without panes of glass to obscure his vision.

Yours very truly, W. M. ACWORTH.

[It is encouraging to find that our editorial notes on English railways are considered as being fair to those railways by such an authority as Mr. ACWORTH, the author of "The Railways of England," and the points raised in his letter are easily dealt with. Our own experience with the lighting of cars on a number of English roads showed that there was very great room for improvement both in the lamps themselves and in the management, the great defect being the smallness and dimness of the flame. With two brilliant lights, in lamps of the present style, one at each side of the roof of each compartment, there would be a sufficiently diffused light to allow of passengers reading without straining their eyes. There are many ill-lighted trains on American railways, but taking the principal lines as a whole, and comparing them with the principal English lines, the American trains are far ahead of the English ones as regards lighting and heating. The channel steamers referred to on pp. 243, 274 and 342, need not be larger to have much better saloon and cabin arrangements and fittings. Deck saloons might not be advisable, but the present ones are capable of very great improvement. The objections to the American style of pilot house, which were referred to on p. 342, will not hold, as the arrangement is in universal use on our river, sound and coasting steamers, steam ferry-boats, etc., and what with fog, snow-storms, ice and wind, the steering of these steamers in winter off dangerous coasts and across crowded rivers is at least as difficult as on the channel routes. The sashes are movable, and a hood or awning projecting from the eaves of the house protects them from anything but a direct head storm; and even with them open in bad weather the pilot is standing in a sheltered position in a steam heated room, instead of being exposed to the wind and rain. The conditions here are more severe than on the channel service, but are successfully encountered by the American pilots in their sheltered pilot houses.—ED. ENG. NEWS.]

### The Hurontario Ship Railway.

COBOURG, Ont., May 1, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have read with much interest Mr. CORTHELL'S paper on the Hurontario Ship Railway. I am glad to see that you commented on it as a little one-sided and partial to his own scheme. The problem of bringing the three upper lakes closer to the Atlantic has been a study with me for many years, and I cannot quite agree with many of Mr. CORTHELL'S conclusions. The ship railway would doubtless have its traffic and be of use; I think it would pay dividends; but I am merely quoting the opinion of those who know the St. Lawrence below Kingston well, when I say that to deepen the river and the canals to 20 ft. of water would involve an enormous expenditure which is not likely to be undertaken for many years to come, if at all. Consequently he may as well leave Montreal out of his calculations altogether and assume Rochester and Oswego as the lake termini of his inland navigation, and that these points will take the place which Buffalo holds at the present day. This is doubtless a gain in shortening the railway journey to New York, and, I think myself, a sufficient gain to warrant the construction of the ship railway, but it is not sufficient to effect the enormous saving Mr. CORTHELL figures out.

The rate of 3½ mills per ton mile, which he assumes for the ship railway, seems to me absurdly low as compared with the 5 mills on ordinary railways. When we consider that he has to move not only the vessel's cargo but the vessel herself and her engines and equipment, as well as the cradle and wheels which support her and the locomotives which draw her, the ratio of non-paying to paying load could not be far from 2 to 1, or about what it is on an ordinary freight train, besides which he has to allow for raising and lowering his vessel, and for interest on a capital five times as great mile per mile as that required for an ordinary railway.

I think, too, that he condemns without proper investigation the Ottawa River canalization, which is to my mind the true solution of the problem.

The raising of Lake Nipissing and the flooding of the ad

jacent territory and of the Canadian Pacific Railway is not an essential feature, and its elimination would reduce the lockage by some 50 ft. The "rock, everywhere rock," is an element of increased cost when it comes to through cuttings, but very little of this is necessary; and for slack-water navigation, by rock fill dams, the rock bottom and sides are precisely what we should ask for, and the amount of masonry necessary for locks and spillways is very much reduced by its presence. Again, works in solid rock cost practically nothing for repairs and maintenance, and I see no reason why these items should be a greater loss than they are on the Sault Ste. Marie Canal, where, according to your own columns, they aggregate 3% of the capital.

Mr. CORTHELL estimates 8,000,000 tons annually, which corresponds very closely with my own estimate. If each ton could afford to pay $1 in canal dues, we should have a revenue of $8,000,000 at 10% on the $80,000,000, which is Mr. CORTHELL'S own estimate of cost. I think that the estimate is high, but, allowing it to stand, we have, after deducting 10% for operations, a balance of $7,000,000 for the shareholders, which is more than he calculates for in estimating his own rates. The distance from Chicago to Montréal is something less than 1,000 miles, which, at his 1½ mills per ton mile, would cost $1.50; add canal dues, $1, and we have a total of $2.50, or less than the rate he quotes from Buffalo to New York alone. Again, as to time, I think he has made an unfair estimate for the Ottawa navigation. The total lockage would be something less than 650 ft., or, say, 33 locks of 18 ft., each of which, at his own estimate of 30 minutes, would take 18 hours to pass. The total time between Chicago and Montreal would then be:

| | |
|---|---|
| 600 miles lake at 15 miles per hour | 40 hours. |
| 36 lifts | 18 " |
| 50 miles canal at 7 miles per hour | 7 " |
| 350 miles slackwater at 10 to 15 an hour | 28 " |
| Total | 93 hours. |

About the same as his own estimate for the ship railway, which I think he will find it difficult to adhere to.

A little editorial discussion of the question in your own columns would, I am sure, be intensely interesting to a great many of your readers besides myself and Mr. CORTHELL.

I quite agree with the latter gentleman in his condemnation of the Trent Valley route as quite unable under any treatment to fill the want which is certainly felt of a cheaper route for grain from the Mississippi Valley to the seaboard.

HENRY K. WICKSTEED,
M. Can. Soc. C. E.

[We are disposed to agree in general and in detail with our correspondent's statements, with some trifling amendments tending to still further strengthen his position. The Ottawa River is a route marked out by nature for direct communication between the Great Lakes and the Atlantic; it can be made navigable for much more than 20 ft. draft for much less than $80,000,000; will not require nearly 50 miles of canal navigation proper, and will not require more than 18 locks (more or less) of 36-ft. lift, instead of 36 locks of 18-ft. lift. That the river banks are almost wholly solid rock is, as our correspondent truly says, a great advantage rather than a disadvantage, since rock can be excavated very cheaply nowadays, and the total quantities to be removed are enormously reduced by the rock; while the rock also makes possible certain important indirect economies which would be otherwise impossible, like dispensing with much masonry, and using a few locks of great lift rather than many locks of small lift.

We should be glad to do whatever we might, in these columns or otherwise, to further so grand a project; but under existing conditions what is the use? So great a work cannot be carried through without governmental aid. The United States Government will do nothing for it, because the route lies outside of its own territory. The Canadian Government is not likely to do anything for it, first, because it has rather overloaded itself with governmental subsidies, and, secondly, because (from a superficial point of view at least), the chief benefit of the canal would accrue to the great cities and states along the American coast of the upper lakes, the Canadian side (with the exception of Manitoba) having small population and less commerce. Thus between two stools the project falls to the ground. The American Government would build it, but can't; the Canadian Government could build it, but won't. Had the route lain within American territory it would have been built long ago, and probably at government expense as a free highway of commerce, so great is the opportunity. Were the route to-day under American control it would not be two years before work on it would be under way, but with one country to reap the chief gain and another country to pay the chief price for it, the prospect for any immediate action is poor.

Mr. CORTHELL'S ship railway in connection with a similar one from Lake Ontario to the head of deep-water navigation on the Hudson may also be a good project; we think it is, but we have not studied it sufficiently to express any positive opinion. But, as respects navigation down the St. Lawrence, it seems to us to be of small promise, owing to the immense difficulty of improving the St. Lawrence for even 20-ft. draft. The all but certain effect of the Hurontario Ship Railway, therefore, if successfully constructed and operated, would be to cause the construction of another like line to the Hudson, which would then be no longer an experiment, and for which, consequently, capital could be raised on easy terms. This would be the best thing which could happen for the eastern United States, but it would not afford as cheap access to the seacoast from the Western States as the Ottawa route, while it would leave Canada decidedly out in the cold.—ED. ENG. NEWS.]

## Jamaica and Jamaican Railway Works.

MONTEGO BAY, Jamaica, W. I., April 14, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

You asked me to write something about the Island and our work down here. I will begin at the beginning, even at the risk of telling you some things already well known.

Jamaica is about 145 miles long with an average width of 30 miles; area, 4,000 sq. miles (one-tenth of Ohio). The surface is excessively hilly, in places mountainous, and generally crumpled. The Blue Mountains in the east rise to some 7,000 ft. In the middle and west the hills rarely exceed 1,800 ft. The surface in the middle and west, where our extensions are, consists of a yellow and white honeycombed calcareous deposit. The plains on the island are limited in area and alluvial in formation. In places our cuts open up white or yellow marl. The limestone is extraordinary in its nature. The honeycombing is that belonging to sponges of a very loose texture. In addition, it is full of sink holes, cylindrical and generally vertical, of which some are as much as 60 ft. deep. This limestone rarely has a dip. Jamaica is supposed to mean "Land of Springs"—a most outrageous misnomer, for by far the largest part of the Island the limestone is too porous to hold water. All houses here are, or should be, provided with cement tanks to catch rainwater led to them through bamboo pipes from the various roofs that cover a Jamaica planter's establishment. Long droughts are a great drawback to a large part of the island.

The climate anywhere above the 500-ft. line would be ideal, but for the enervating influences incident to all climates where frost is not known. Some "cold snaps" each winter would do the West Indies more good than unlimited Gospel. The climate is very healthy except in certain parts of the coast where one may get malaria, whatever that is supposed to be. Of yellow fever, the Jamaicans know next to nothing. The English government establishes such good sanitary regulations that yellow fever has no chance to acquire a foothold. But for Spanish rule Cuba would be the same. The nights are always cool enough for blankets, except at times on the coast. The days are never sultry, no matter how hot it may be in the sun. One rarely feels uncomfortable from the heat, even in the sun. A perpetual warm spring best describes conditions here, even in summer time. On the coast the heat is not as fierce in summer time as at times with us. These comfortable climates, though, are a bar to all moral, mental and physical progress, and Jamaica is no exception. The population here amounts to 750,000 of which 15,000 only are more or less white. The remainder is nearly pure black. There are probably not more than 5,000 pure whites on the island. The rest are "white by law," a title given to all whose percentage of black blood is small. These creoles are hospitable, and, as a rule, well educated. Their lack of enterprise is due to the still surviving influences of slavery and the climate. The blacks outnumber the *pure* whites 140 to 1. The whites being mostly in the small towns on the coast, you can imagine what an Ethiopian look the interior of the island has. These people will undoubtedly control the island some day. At present they are better educated than our Southern blacks, and far more docile and well behaved. Our blacks, however, are both physically and mentally their superiors. Meat diet and hard work create muscle that yams and lying about cannot produce, and contact with whites in the states means competition in a climate where nothing grows unless attended to. Here no negro need work if he can buy or even rent one or two acres. His home will be a wattle hut, thatched over, surrounded by a little yam patch and some banana or cocoanut trees. He need only work at times at the most to get money to pay his rent.

Jamaica, with over 700,000 belonging to the laboring class, and with a gradually diminishing sugar industry, has to import coolies to do the little hard work required by the sugar planters, whose plantations are very few and far between. The quantity of land under cultivation in Jamaica is hardly worth speaking of, and yet with a dense population, of a purely laboring class, labor must be imported. The Jamaica negro is lazy and stupid, but always good-natured. He takes a day to do an hour's real work, and then does it badly. He is remarkably honest, however, and can be trusted with money and valuables. He will pilfer in a small way rum, yams or eatables.

About the railway work: The West India Improvement Co. is a syndicate controlled by Messrs. E. L. FRANK and FRED. WESSON, of New York. Mr. WESSON, acting for the syndicate, bought from the government some 12 months ago the Jamaica Railway, about 65 miles long. The price was £100,000 in cash and £700 000 in second-mortgage bonds, and an obligation on the part of the syndicate to complete certain extensions, one to Montego Bay and the other to Anotta Bay and Port Antonio, all seaports on the northern side of the island. For these extensions the syndicate is empowered to issue $1,500,000 of first-mortgage bonds from time to time. The extensions are about 120 miles long. The company is obliged to finish but 12½ miles a year. The company has completed its first 12½ miles and expects to add 15 miles more by the end of the second year. So far no construction has been attempted except on the Montego Bay extension, and the work is really in its infancy. You can imagine what a rough country is in Jamaica when I say that we are allowed curves of 330 ft. radius and a 3½% grade (uncompensated). Both curves and grade are used freely. Minimum tangent is 63 ft. The stipulated train time is 15 miles an hour. This grade, with curvature, is not "bunched" in any one part of the extension, but has to be used over the whole line. The surveys are not complete yet, but a rough idea of the grades would be as follows:

| | | | | | |
|---|---|---|---|---|---|
| 5 | miles | + 3½% | 12 | miles | unknown |
| 10 | " | + 2% | 10 | " | light descending |
| 6 | " | − 3½% | 1½ | " | + 3½% |
| 1½ | " | very light | 2 | " | − 1½% |
| 1½ | " | + 3½% | 3 | " | − 3½% |
| 2½ | " | − 3½% | 2 | " | light descending |
| 8 | " | light descending | | | |

The grading of the line is, of course, done by negro labor, put on task work. The men work in the cuts singing; all picks are brought down together. Women carry the material to the embankment in little wooden trays perched on their heads. Rock costs about 62 cts. and earth, of which there is but little, in proportion. The company has a construction department, and so far no contracts have been given. There is a capital chance awaiting a good constructor with capital at this end, where I have just finished three miles of location containing 180,000 cu. yds. of cut and fill, 1,600 ft. of tunnel and a viaduct 320 ft. long.

I have been in charge of a locating party since landing seven months ago. I was first placed at Balaclava in the middle of the extension, with instructions to get over the mountains there with a line. We were fortunate in getting a very easy line where a previous survey by English engineers using the same grades and curves of 660 ft. radius had to put in a three-quarter-mile tunnel to get through with two smaller tunnels. We managed to get through with one 320-ft. tunnel. We hope to begin construction near Montego Bay in a few months. The Chief Engineer is Mr. G. H. LATHAM. Chiefs of parties get $300 and instrument men $150; all get expenses both in the field and on construction. The company is very liberal in its treatment of employees.

J. S. ELLIOTT.

## High Pressure Steam Boilers.

NEW YORK, May 4, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In view of the great interest which is now being taken in the subject of carrying high steam pressures for compound, triple-expansion and quadruple-expansion engines, we beg leave to call your attention to the inclosed list of high-pressure boilers which have been put out by our Glasgow factory.

The pressures given in the last column are the daily working pressures—many of them 200 lbs. and over, and show that it is not only practicable but economical to carry such pressures, if the engine plant is designed properly.

In this country the Babcock & Wilcox Co. has put out a large number of boilers at equally high pressures, among which are those built for the Wood Vulcanizing Co., of New York City, which have been running at 235 lbs. daily pressure for the last 10 years. Another notable example is a battery of four 100 HP. boilers, which have been recently erected at the Baldwin Locomotive Works, Philadelphia, to carry a daily pressure of 225 lbs. A duplicate of one-half of this plant is now being erected for the Schenectady Locomotive Works, and there are a very large number of plants of our make of boiler in the country running very close to these pressures.

Thinking it might be of interest for you to work up some note in relation to this, especially as the call is for greater economy, not only in the line of coal, but also in the space occupied, we send you this information.

THE BABCOCK & WILCOX CO.

[The list is certainly one of no small interest, and therefore we shall have pleasure in reproducing the principal part of it in a following issue.—ED. ENG. NEWS.]

## Rosendale vs. Portland Cement.

NEW YORK, N. Y., May 7, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR:—Under this caption Mr. ALBERT SCULL endeavored in your last issue to demonstrate the relative merits of Rosendale and Portland cement, and concludes from his experiments that the former is superior in strength to the latter, as the age of the sample briquettes increases, but, as his first statement that the base in manufacturing Portland is 66⅔ lime is not quite correct, it may be presumed that the Portland cements he selected for comparison with the Rosendale are heavily limed.

Chemical analysis demonstrates whether a cement contains only its due percentage of lime, and also by the percentage remaining of carbonic acid whether this lime has been properly combined during the process of burning with the silica and alumina. This is most important, as the true cause of failure in concrete work may in nearly all cases be traced either to the use of an excessive proportion of lime in the original mixture, or to some of the lime being present after burning in the free—*i. e.*, not chemically combined—state. This is indicated at once by a percentage of carbonic acid which should in no case exceed 1.50%.

Messrs. Gibbs & Co., manufacturers of Portland cement, publish the yearly average composition of their cement as follows:

| | |
|---|---|
| Lime | 59.47 |
| Soluble silica | 23.63 |
| Alumina and ferric oxide | 10.87 |
| Carbonic anhydride | 1.00 |
| Sulphuric anhydride | 1.65 |
| Insoluble silica | 1.17 |
| Magnesia | 0.62 |
| Alkalies and moisture | 1.59 |
| | 100.00 |

It will be a very great surprise to architects, engineers and contractors to learn that the best brands of Portland cement after an age of 2 years show a decided decrease of strength and fall away, or, in other words, become weaker, which means disintegration and final failure. But I maintain that this assertion of your correspondent is controverted by the facts, for Portland cement has been used for concrete construction and the manufacture of artificial stone in this vicinity for the past quarter of a century and in England since 1850, for not only have heavy foundations and dock walls in different parts of the world stood the disintegrating effects of water, but the artificial stone constructions in Central and Prospect parks and elsewhere have weathered and are more perfect to-day than if built of natural stone.

The Portland cement pavements that have been properly laid during the last 10 years are silent witnesses that they stand heavy traffic and do not disintegrate; whilst some pavements that were first made with Rosendale cement have long since passed into innocuous desuetude. Rosendale is a satisfactory material for certain work, but the increasing employment of Portland cement is due to its economy for rapid construction and ability to carry a compressive load without crushing at shorter date. A word of caution to engineers and contractors against the employment of low-priced Portland seems appropriate at this time, as in the effort to make business, material that is only styled Portland cement through the barrels being thus labelled is sold as "best," and much dissatisfaction and loss have been incurred. For all work, if no time for exhaustive tests can be given, the users should select for tenders a few well-known brands that are noted for uniformity and have been repeatedly tested.

HOWARD FLEMING.

## Notes and Queries.

LOCKS AND DAMS IN ALLUVIAL SOILS.—A treatise on this subject, other than as contained in the reports of the Chief of Engineers, U. S. A., is inquired for. We are unable to recall any.

LEVEE BUILDING.—Our correspondent who inquired for a book on this subject is referred to "Hewson on Levees" (1878), further particulars in regard to which can be obtained from Mr. H. St. L. Coppee, of Vicksburg, Miss. Since the date of this work, however, the art has greatly advanced.

H. S. T.—Drills with diamond-cutting edges are made in this country by the Pennsylvania Diamond Drill Co., Pottsville, Pa.; the American Rock-Boring Co., 15 Cortlandt St., New York; the M. C. Bullock Mfg. Co., Chicago, Ill., and others. The stones used are of an inferior variety, worth about a fifth as much as those suitable for ornaments. The cost is now about $5 a carat.

H. C. C.—Storage batteries on street railways can hardly be said to be a commercial success as yet. Probably the most successful line in this country is the Beverly & Danvers Street Ry., which has been in operation since October, 1889. This line runs over a number of hills and on the down grades the motors act as dynamos, charging the batteries. The Edco cars are used in Washington on the Eckington & Soldiers' Home Ry., in Pittsburg, Pa., and in Dubuque, Ia., on the Dubuque Street R. R. The Citizens' Street Ry. Co. in Indianapolis also operates storage battery cars. Mr. C. O. MAILLOUX, of New York, is electrician for the Metropolitan R. R. Co., of Washington, D. C., which is now building a very interesting combined storage battery and trolley plant, which will probably embody all the really practical uses of the storage battery in its present stage of development.

## The Pancoast Ventilated Car.

A new idea in the preservation of fruits, vegetables and other green produce in transportation has been developed by Mr. R. M. PANCOAST, C.E., of Camden, N. J., of which we have heretofore given some brief

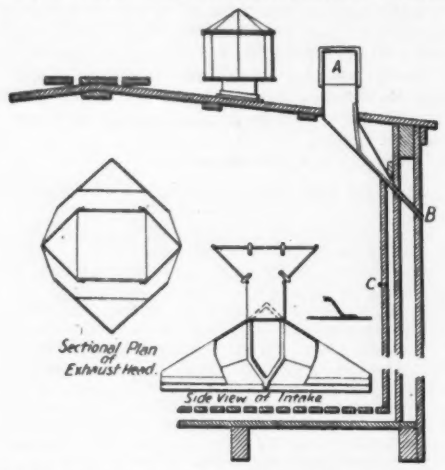



Fig. 1. Vertical Section of Pancoast Ventilated Car.

description. His theory is that thorough ventilation, bringing a constant current of fresh, dry air in contact with the fruit will preserve it from decay a longer time than the ordinary method of shipping, in which a refrigerator car is used and the fruit is kept at a low temperature.

Without reproducing the inventor's arguments in support of his theory, it may be said that cars built on this principle were in service last season and excellent results are said to have been obtained, especially in the shipment of grapes from western New York to the Philadelphia market. Mr. A. S. WATSON, Business Manager of the Western New York Grape Growers' Association, states that a carload of grapes shipped in a Pancoast ventilated car arrived in good order and free from mold at a time when grapes from the same section shipped in refrigerated and other cars were badly molded. The

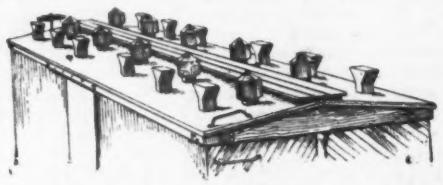


Fig. 2. Roof of B. & O. Freight Car. Fitted with Pancoast Ventilating System.

car has been used in the California fruit trade with good results.

The method of construction at present used by Mr. PANCOAST is shown in Fig. 1. The air enters through a screened opening at the intake *A*, a side view of which is also shown in Fig. 1, and strikes against a deflector, by which any rain-splash, dirt or cinders which may pass the screen are collected and discharged from the nozzle at *B*. The purified air then passes down between the sides of the double walls, and thence underneath the false floor, which is made of slats, through which it rises to circulate among the fruit or other produce with which the car is loaded. On the roof of the car is also placed a double row of exhausts. A horizontal section, showing their construction, is given in Fig. 1. It is claimed that no matter from what direction the wind comes, these exhaust heads will exert a suction on the air in the car. A perspective view of the roof of a Baltimore & Ohio car fitted with the Pancoast ventilating system is shown in Fig. 2.

It is also claimed that the car is especially adapted to the transportation of grain in bulk. For this use the false bottom, which is made in sections, is removed, and placed in racks at the end of the car. The horizontal air door, *c*, located just above the surface of the grain, is then fastened open, and the current of fresh air enters directly over the load. For use as an ordinary car or a winter car, the ventilating intakes and exhausts may be closed by dampers. It will be seen that reliance is placed on the motion of the car while running and on the wind while standing to keep up the circulation of the air; and it is claimed that the exhausts and intakes will give a positive ventilation, no matter what the direction of the wind.

Of course the perishable freight for which the car is intended is generally unloaded very soon after its arrival; so the fact that the ventilation is very small when the car is standing unless the wind happens to blow is probably of not much importance. The importance of this invention to shippers and to the railways, provided it continues to show improved results in practice over the ordinary refrigerator car, may be appreciated by the light of the recent Census bulletin on truck farming, which shows a total value of vegetables shipped by rail or water to market of $76,517,155 after paying freight and commissions. This does not include any of the fruits, small or large; and when these are included the value of the shipments must at least be doubled. If Mr. PANCOAST's idea that good ventilation is the great desideratum in preventing decay be proved correct, its great economic importance is evident.

## Stopping the Leak in the Coffer-Dam at the Sault Ste. Marie Canal.

In our issue of April 11, p. 357, the break in the coffer-dam at the new Sault Ste. Marie Canal was described. The break occurred on March 19, and the lockpit was entirely filled, submerging all the contractors' machinery. The dam is built on a rock bottom, so that piles could not be used, and consists of two parallel lines of timber cribs, each 20 ft. wide, filled with stone, between which is an 8-ft. bank of clay. The break washed out the clay bank for a distance of 50 ft., but fortunately left the cribwork intact. At the deepest point the channel made by the break was 4 ft. below the bottom of the crib and 26½ ft. below the level of the water in the present canal, or about 9 ft. lower than the level of the water in the river below the lock.

The methods used in repairing the break are described as follows by Gen. O. M. POE, U. S. Engrs., in a letter to the *Marine Review*:

The rush of water underneath the dam was so great that bales of hay and gunny-sacks filled with clay thrown into the cavity were carried through. By driving sheet-piling on the down-stream side of the space from which the clay wall had been carried away a sufficient obstacle was established to prevent hay in bales and clay in sacks from being washed through, and after some two thousand sacks of clay had been thrown in it became possible to fill the gap with loose clay.

But the leak still remained too large for the pumps to handle, and to further reduce it, as well as to get something into place more substantial than the sheet-piling which had been driven at first, timbers 12 ins. square, sharpened to a chisel edge at the lower end, and shod with iron to the extent of the ability of the entire blacksmith force at the Sault to manufacture, were driven with a 1,900-lb. ram between the sheet-piling and the cribwork until they could be driven no further, when it was assumed that they were in contact with the rock formation, and a note was made of the depth to which they had gone. The clay wall was then loaded with heavy piles of stone to compress it, and the result was a reduction of the leak to such a degree as to bring it easily within the control of the pumps; and 19 days after the break the lock-pit was again empty of water. The volume of water in the pit was about 45,000,000 galls., and this, in addition to the leakage, was handled by the pumps in less than 7 days.

Although the pumping capacity available was sufficient to easily keep the lock-pit empty, it was still very desirable that the leak should be entirely stopped, and it was believed that this could be done very soon after its exact location was ascertained. To find the crevice in the rock through which the water was passing an iron rod was driven down through the clay wall in front of and close to the timbers already referred to, until it would go no further. The depth to which it penetrated was compared with the depth to which the timber had been driven, and the proper notes were made concerning any effect upon the muddiness of the leak. The rod was then withdrawn, moved laterally an average distance of 8 ins., and again driven to the rock. This operation was continued until at one place the rod went 2½ ft. deeper than at a distance of 8 ins. on either side of it. Here, then, was the crevice sought, and the next thing to be done was to

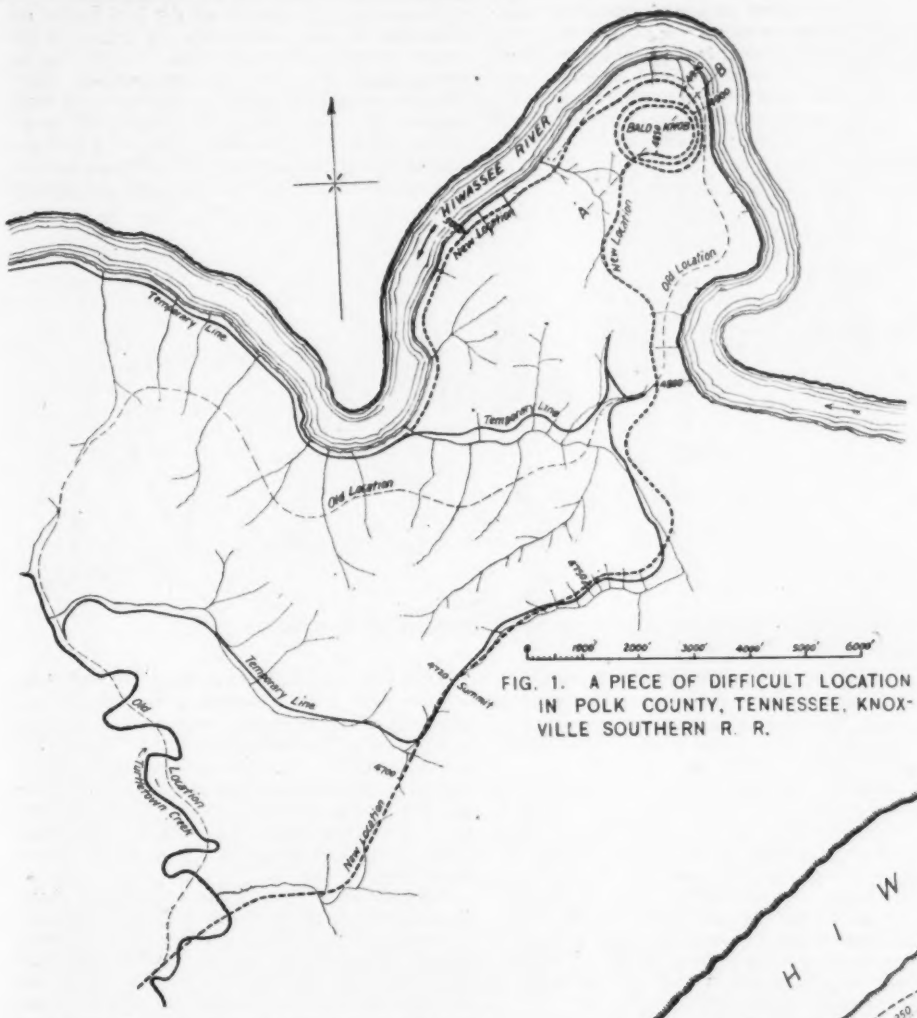



FIG. 1. A PIECE OF DIFFICULT LOCATION IN POLK COUNTY, TENNESSEE, KNOXVILLE SOUTHERN R. R.

fill it with clay or other water tight material. It was nearly 30 ft. below the top of the clay wall, and more than 26 ft. below the level of the water in the canal. It was not practicable to excavate down to it, and no other mode than that known as "stock-ramming" seemed available by which to put the clay "where it would do the most good."

Stock-ramming consists simply in driving a tube of requisite diameter to such depth that its lower end will be at the point where it is desired to deposit the clay or other impervious material, and then forcing such material through it in such quantity as may be necessary. In this particular case the tube used is an iron pipe. An iron rod is used as a piston, and this piston is driven down by a pile-driver, the clay with which the pipe had been filled being forced out at the lower end. When the piston has reached the lower end of the pipe it is withdrawn, the pipe is again charged with clay, and the operation of forcing it out is repeated. This is continued until the clay rammed in forces upwards the whole column of clay above it, when, as is obvious, the operation can be carried no further. The whole operation is a simple one, and resembles nothing else so much as stuffing sausages, which, I dare say, first suggested its use many years ago

The leak had been stopped before the ice had been got out of the canal. As soon as the canal could be cleared of ice the movable dam was double-battened, the valves of the lock were opened, and for the first time since the completion of the present lock the water was drawn off from that portion of the canal below the movable dam. More than half of the bottom was laid bare. The withdrawal of the water from the canal of course reduced the upward pressure upon the clay wall of the coffer-dam, and the mass of clay, 30 ft. high, compressed under its own weight as much as 18 ins. in the case of the new clay put in at the site of the leak.

The successful manner in which this leak was dealt with greatly increases our confidence in our ability to control any which may occur in future, but it does not remove our anxiety. That will abide with us until we no longer need the dam. But we regard the dam as now better than ever before, and the experience gained will enable us, in case of any future leak, to apply the most efficient remedial measures in the shortest possible time.

It was never supposed that a work like this could be carried on, under all the surrounding conditions, without great difficulty and many annoyances. But for the necessity of providing for navigation while the new work is in progress the work would be simple enough. All the trouble we have thus far encountered has arisen from this necessity.

## A Piece of Difficult Railway Location on the Knoxville Southern R. R., in Polk Co., Tennessee.

We are indebted to Mr. FRANK O. SINCLAIR, of the firm of Sinclair & Leavenworth, Chattanooga, Tenn., for the accompanying maps and profile of a piece of difficult railway location on the line of the Knoxville Southern R. R., made by him in the winter of 1889-90.

The Knoxville Southern R. R. extends from Knoxville, Tenn., to a connection with the Marietta & North Georgia R. R., near the Georgia State line, about 100 miles north of Atlanta. The road was built in 1889 and 1890. It is about 100 miles in length, and some of the location was made through very difficult country. For 10 miles or more it was necessary to follow the valley of the Hiwassee river, a stream whose bed at the point where it was decided to enter the valley lies from 600 ft. to 800 ft. below the level of the surrounding country. Mr. SINCLAIR describes the work done in locating a line to make this descent of nearly 400 ft. as follows:

A line not shown on the map, using a 2% grade, was first located, but it was afterward decided to use a lighter grade, so the line marked "Old Location" was laid out using a 1.33% grade not compensated for curvature. This line gave such exceedingly heavy work that in trying to avoid a part of it the last or "New Location" was found, using a 1.4% grade compensated for curvature.

It was necessary to have trains running between Knoxville and Atlanta by a certain date. Before the new location was found it was expected that the "old location" would be the permanent line; and it being impossible to construct that line within the time specified, the "tempo-

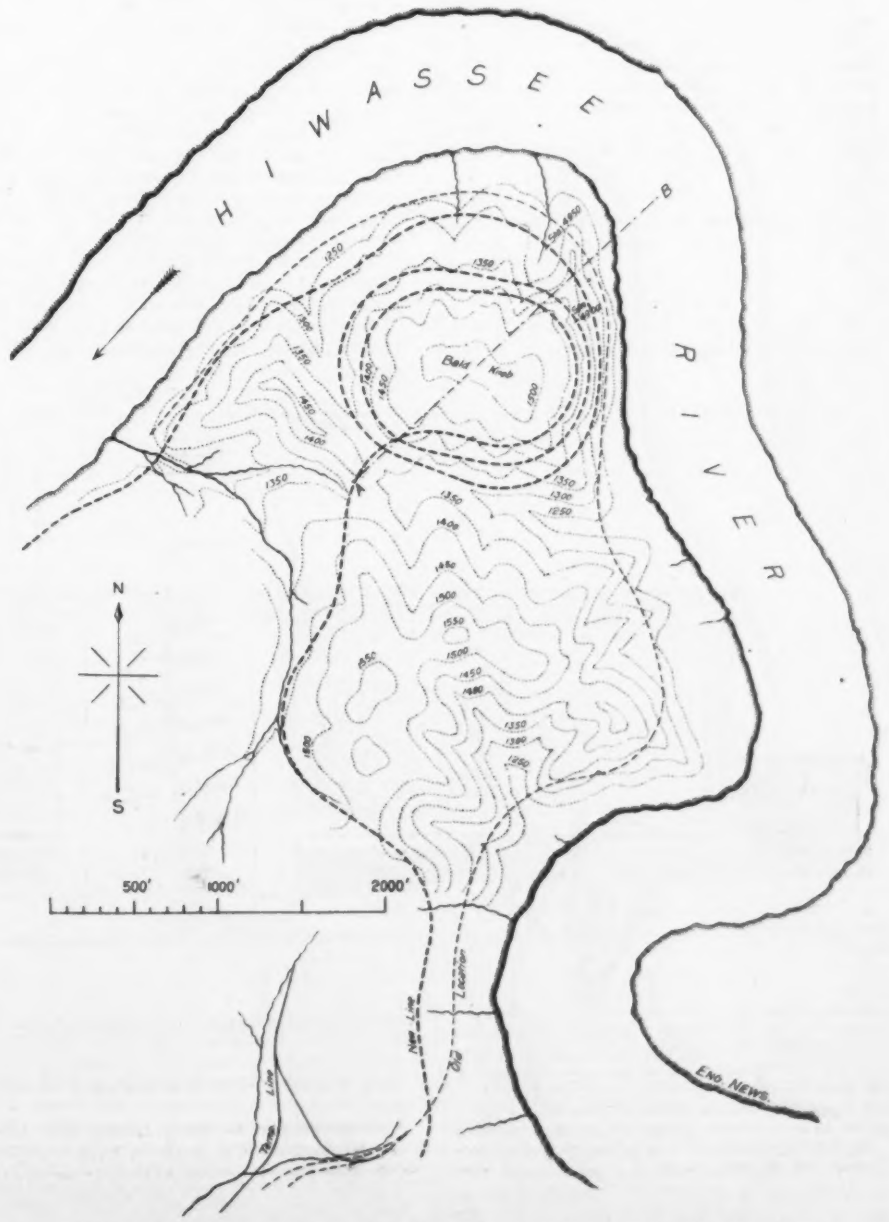



FIG. 2. MAP OF LOCATION AROUND BALD MOUNTAIN, SHOWING CONTOURS.

rary line" shown on the map was made. The grades of this line vary from 2⅛% to 4⅛%, with no compensation for curvature. The maximum curve is 20°, and there is one switchback as shown on the map.

The profile of the new location is shown in Fig. 3.

A profile of the mountain on the line marked *A B* on the map is also shown, with the points where the grade line of the spiral intersects it. There is one 13° curve on the spiral, which is the sharpest on the whole line.

The grading of this "new location" is about half completed, but owing to financial difficulties work was stopped Dec. 1, 1890. It is uncertain when work will be resumed, though it will probably not be until after a receiver has been appointed and the road sold.

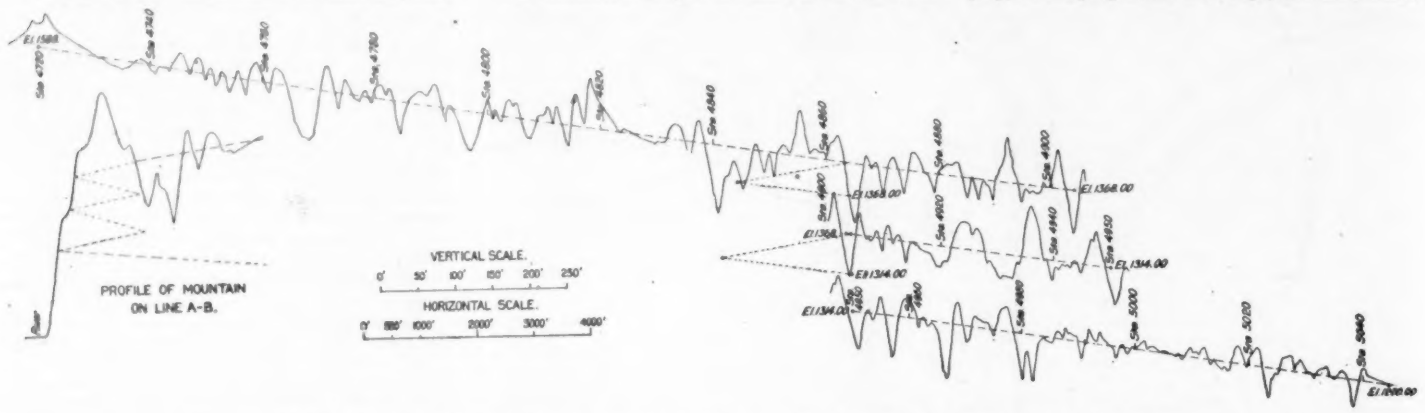



FIG. 3. PROFILE OF DESCENT TO HIWASSEE RIVER BY NEW LOCATION, KNOXVILLE SOUTHERN R. R.

Should the construction of this line be completed, as now appears probable, it will be the most elaborate series of railway spirals in the world. A still more elaborate series of spirals, five in all, was located by Mr. A. M. WELLINGTON in Mexico, and is shown on p. 684 of the "Economic Theory of the Location of Railways," but these were not constructed, as a better line, shown in the same connection, was finally discovered.

## The Comparative Merits of Various Systems of Car Lighting.

IV.

THE CARBURETER.

We now come to the carbureter. The main features of its construction as used on the Pennsylvania R. R. are shown in Figs. 28, 29. The construction now favored by the manufacturers differs in some details as hereafter noted. The abuse to which this part of the plant can be subjected without destruction will be graphically shown hereafter. It is difficult to imagine what more can be done than has been done in this device to make the carrying on cars of gasoline for lighting purposes safe and secure; yet, on the other hand, the tests illustrated in these cuts do not, in our judgment, subject the carbureter to as severe treatment as it may have at times in railway accidents. We describe the round carbureter, as the one tested by us. A large square carbureter has lately been introduced as noted below.

The carbureter proper is made of No. 18 cold-rolled copper, about $\frac{1}{16}$ in. thick. The bottom and sides are struck up by a die in one piece, without soldering. The compact mass of wicking filling is then placed *en masse* inside of the copper shells, being put together as follows:

Two parallel plates, 4 ins. apart, are perforated by a series of ()-shaped holes for the wicking, as may be seen in part in Fig. 30, these holes being arranged to form a spiral like that shown in plan in Fig. 29. These plates are then connected by a continuous strip of metal, soldered in a spiral to both the parallel plates along the lines shown in plan in Fig. 29. The interior frame, or head, is then ready for the wicking, which is put in by boys with much dexterity, strand by strand, and cut off so as to make a tolerably smooth surface, called the "mat."

This interior filling, which is to all appearance a mere solid mass of partly compressed wicking (except that wicking is left out of the three or four holes nearest to the air inlet and gas outlet), is then forced into the copper case, which requires considerable pressure, as the fit is tight, and the top cover-plate of copper is then put on, and fastened by the very careful and elaborate joints which are sufficiently shown in Fig. 28. The similar arrangements for inserting the central tube (5¼ ins. in diameter and the several air and fluid openings, we need not stop to particularize.

About 12 lbs. of wicking (of the best grade) are thus used for each carbureter, the weight of the copper used per carbureter being 18¾ lbs. and the total weight of each carbureter complete (apart from its outer case) being 33 lbs. The four galls. more or less of gasoline which the wicking will absorb will weigh some 21¾ lbs. more. The outer casing or mantle, which serves at once for protection from injury, for keeping off the solar rays, and for furnishing a chamber in which hot air from the roof of the car and part of the products of combustion may circulate around the carbureter and keep it warm, is then added. This casing, or "mantle," is made of a double thickness of ordinary kalamein iron, packed between with straw board so as to be ¼ in. thick in all. The bottom of the outer case consists of a single sheet of kalamein iron. The carbureter complete is firmly fastened to the roof of the car by the straps 23 and bolts 25, Fig. 29.

The openings into the carbureter are (1) the charging appliance, consisting of the filling valve and the discharge valve, 16, 18, Figs. 28-9, shown in more detail in Figs. 30, 31; (2) an opening (5-17, Fig. 28) by which air enters the carbureter near its center, and (3) a gas exit, marked 7-17, near the outside of the carbureter, where the mixture of air and gasoline vapor escapes, to pass through the pipe 8, 9, 10, 11, to the burner. The top of one arm of the lamp, where the gas connection is made, is visible in Fig. 28, and Fig. 32 shows, to larger scale, the carefully made gas-tight joint which is used, and which, so far as we can learn, never gives any trouble by leaking.

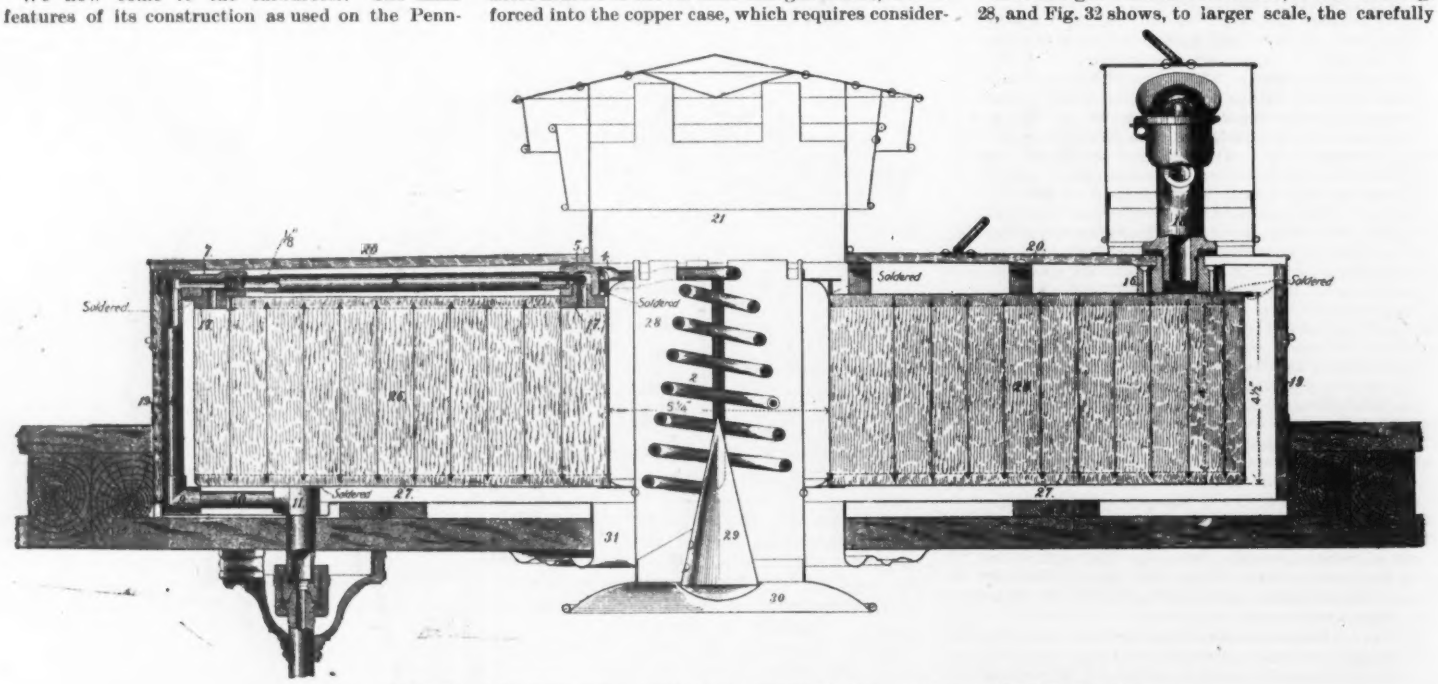



FIG. 28. SECTION OF STANDARD CIRCULAR CARBURETER, PENNSYLVANIA RAILROAD.

Three fundamental details in regard to the carbureter are the air supply, the method of keeping it warm, and the charging arrangements. The air supply under Penna. R. R. practice is shown clearly

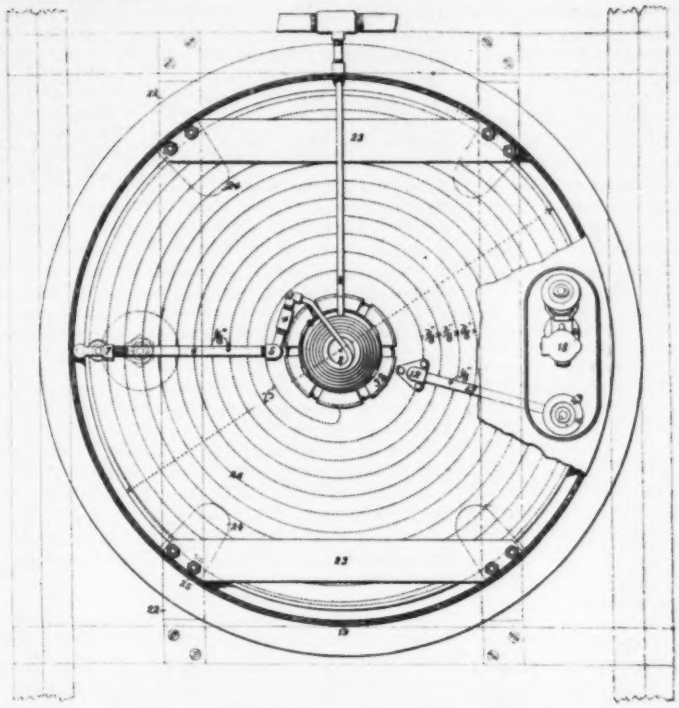


FIG. 29. PLAN OF STANDARD CIRCULAR CARBURETER, PENNSYLVANIA RAILROAD.

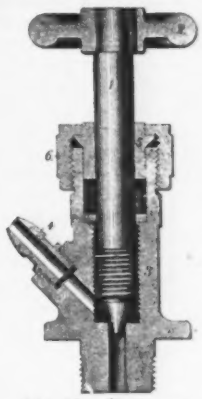


Fig. 31. Discharge Valve.

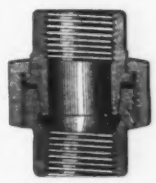


Fig. 32. Joint between Carbureter and Lamp.

in Figs. 28, 29. A copper coil of $\frac{3}{32}$ in. interior (⅛ in. exterior) diameter is placed in the middle of the central space, through which most of the gases of combustion from the lamp go up. The air enters from the deck pipe at the bottom of this coil, and thence, after passing throught it, enters the carbureter at the aperture 5. Here the air is compelled to enter into and go through the wicking, if it enters at all, since the air connection is only with the inner part of the spiral. It may, however, follow this wicking

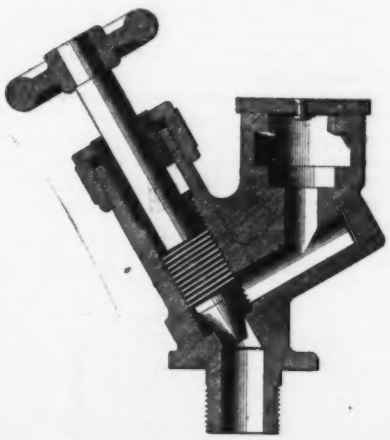


Fig. 30. Filling Valve.

downward to the bottom, and thence take a shorter horizontal path through the bottom of the wicking instead of following the spiral, if it can. Or, if the pressure be not sufficient to force it through, as there is back pressure against it, it may do neither the one nor the other. It will obviously take the path of least resistance and is supposed to follow the spiral wicking space. We shall shortly see, however, that the air supply not only does not, but that it cannot, under certain unfavorable conditions at least, either in part or whole, follow the wicking. The air enters from the copper coil at a temperature of 300° to 350° F., but enters in such a small volume that it is undoubtedly cooled down very quickly to the boiling point of gasoline, 90 to 110° F., or below it if the interior of the carbureter is not heated up to that point.

The Frost carbureter company no longer use this copper coil, but enter the air supply from the deck tube directly at 5, a difference of practice which is not approved on the Pennsylvania road. In each case alike, however, there is a further important detail of the air supply yet to be described, viz., the "by-pass," by which a supplementary air supply is admitted to the gas at its exit. This by-pass is clearly shown, but (unfortunately) not numbered in Fig. 28, and lies between the "7" and "¼." The aperture is quite small, $\frac{1}{32}$ in., but it is large enough to supply a very considerable amount of air per hour (much more than appears to be used under any circumstances, as we shall shortly see), without subjecting it to the resistance of the wicking spiral, through which latter, it would seem, little or no air would be likely to pass as long as the demand for air is sufficiently supplied through the by-pass.* Delivery of air through the by-pass also, therefore, can only cease when there is a pressure of steam at the gas exit of at least 3 lbs. per sq. in. If there be a still higher pressure than this, as at times happens with the plant as now supplied by the manufacturers, there will be a tendency for the vaporized gasoline to reverse the current through the by-pass and flow backward into the deck pipe, where it will condense. This fact we shall hereafter have occasion to refer to. The same tendency

*On the other hand it is claimed that the by-pass and the spiral passage way through the carbureter are two passage ways which the air is at liberty to follow, and the connections to these being opened, the air will follow both passage ways in amount directly proportional to the resistances. It is assumed that the passage way through the spiral is so choked with the wicking, that no air will pass that way, but when the by-pass was first devised, this point was very carefully considered, and experiments were made showing the relative resistances. When the aperture to be used in the by-pass was decided on, which is now 1-32 in diameter, we made a number of experiments on the relative resistance of the passage of air through the spiral and through the 1-32-in. aperture. The absolute amount that passes through the two is not a constant, because when the carbureter is first charged less air passes through the spiral, and relatively more through the by-pass, than when the carbureter is nearer dry, but proportions, as near as we can get at them without making absolute test, are that approximately 10% of the air passes through the by-pass, and the rest of it through the spiral. These figures, as said above, must be regarded as approximate, and as variable, depending on the condition of the carbureter. That some air must pass through the wicking, if not most of it, will appear evident from two or three things: First, the apertures through which the wicking is drawn are ⅝-in., while the sides of the spiral are ¾-in. apart. There is, therefore, as shown on accompanying pencil sketch, a free passage way for air at the top and bottom of the spiral [of ⅛-in. on each side.—ED.], even assuming that the wicking when saturated with gasoline fills the spiral near the middle. Experiments can be made on this point, if desired, but we are very confident that the facts are as stated by us. Second, if it be true, that air does not circulate through the carbureter, it would be impossible to light a carbureter lamp at all, unless there was enough pressure inside the carbureter produced by gasoline vapor, to have some go out of the carbureter, without any air going in. We have lighted a carbureter lamp, having a by-pass, and everything according to our standard construction, when there was no fire in the car, and the carbureter had been exposed for two days, to a temperature of 10° Fahr. To our minds this is absolutely conclusive that air goes through the carbureter, for no gasoline vapor would pass out of the carbureter under these conditions, unless something pushed it out.

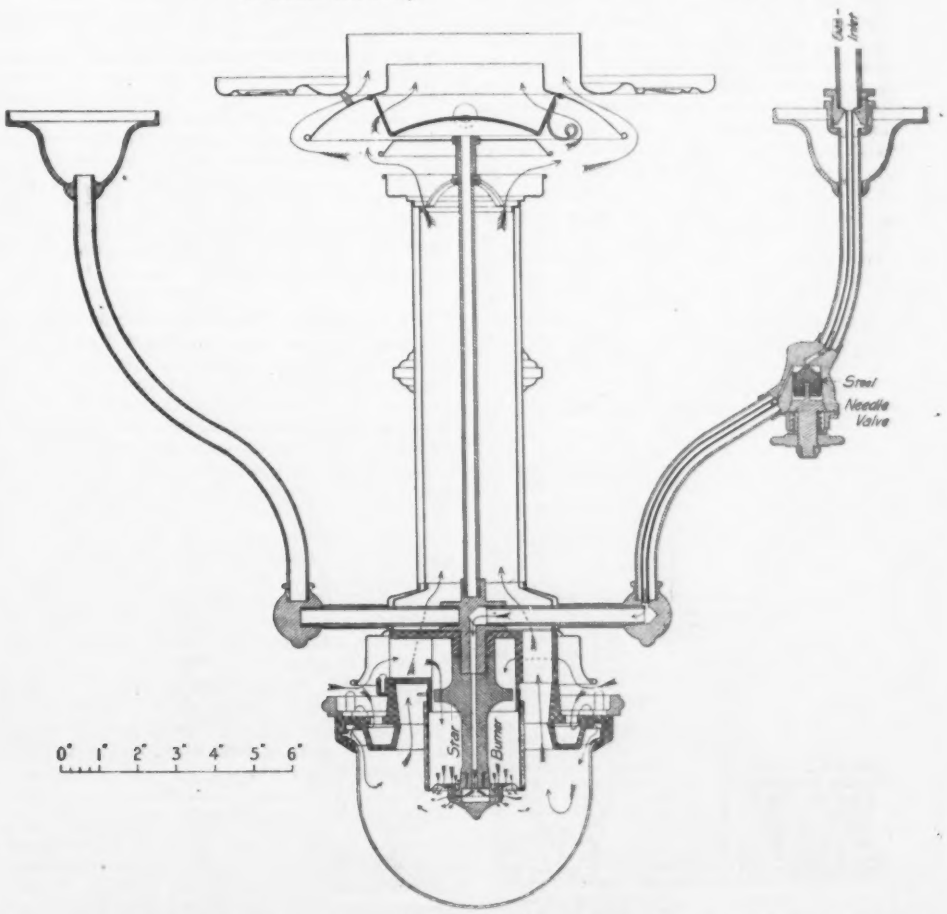



FIG. 33. STAR BURNER, OF THE REGENERATIVE LUNDGREN TYPE, THE PRESENT STANDARD LAMP.

will arise should the rays of the sun heat the carbureter above the boiling point, but in this case there is not likely to be any condensation in the deck pipe at first, as it will presumably be still hotter. As the sun's rays grow colder, however, the copper pipe will cool with it while the carbureter is still hot, and hence there is then opportunity for a considerable condensation in the copper deck pipe, which is of ½-in. diameter. The most which could happen while the sun's heat is rising or stationary is that the pipe leading down to the burner should gradually fill with condensed gasoline, which would escape in liquid form when it was attempted to light the lamp. We have no knowledge of any incident of this kind having ever occurred; but it is known that gasoline steam is generated by the sun's heat so as to cause a blow-off through the safety valve not infrequently, and whenever such blow-off occurs there would appear to be liability of the lower gas pipe filling up with condensed gasoline, but very slowly, and probably not injuriously.

To protect the flame of the lamp from downward rushes of air tending to extinguish it (which occurs chiefly or only when brakes are suddenly applied) a cone, 29, is (in P. R. R. practice, and formerly in all practice) put in to divert any downward draft of air, and this also has the effect to slightly check the free escape of hot air and gases up the central tube. An open space, 31, is formed around the central tube, by which the hot air in the top of the car and part of the gases of combustion (in P. R. R. practice a very little part, probably) can escape up into the open space between the carbureter proper and its casing. This hot air spreads about under the bottom space, 27, then rises around the sides, and then returns again to the ventilator, 21, where it mingles and escapes with the gases arising through the central passage. By decreasing the freedom with which air escapes from the ventilator, the temperature which the carbureter normally attains can be increased up to any temperature which the flame of the lamp below can maintain.

This the manufacturers of the plant now prefer to do. As will be seen from the accompanying drawing of the lamp now used (the "star burner," Fig. 33), a solid diaphragm, perforated with comparatively small openings only, is placed directly above the lamp chimney, through which perhaps half of the gases of combustion pass directly up the chimney, and the remainder of these gases, mingled with a certain amount of the heated air in the top of the car enters the annular side passage only (131, Fig. 28), and thence circulates around the carbureter, thus tending to heat it somewhat warmer than does the arrangement of passages shown in Fig. 28.*

How great the resulting difference of temperature may be is now being made the subject of experiment, and we shall be better able to speak later. The manufacturers claim that the arrangement as to the exit of gases, shown in Fig. 33, is preferable to that of Fig. 28 for another reason, viz., that sudden shocks, as in switching, will at times cause a downward puff through the ventilators which extinguishes the lamp.* We are not accurately advised as to the extent of this danger with the arrangement of Fig. 28, nor of the extent to which it is remedied by the arrangement of Fig. 33, but it is obvious that there may be considerable difference, since there is a clear annular space around the cone 29, Fig. 28.

*(To be continued.)*

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THE FIRST SOD FOR THE DETROIT RIVER TUNNEL was turned April 30 by Mr. J. D. HAWKS, Chief Engineer of the Michigan Central R. R.

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THE *Chronicle* BUILDING, in San Francisco, is 10 stories high instead of three stories, as stated in our issue of April 18, through a typographical error.

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A STEP TOWARD THE ADOPTION OF A UNIFORM FARE has been taken by the Cork, Blackrock & Passage Ry., of Ireland, which is a local and suburban line. On the service between the city of Cork and Crosshaven and Aghada, two favorite tourist resorts in the harbor, there will be two sets of fares, one by rail between Cork and Passage, about 6½ miles, and the other by steamer between Passage and Crosshaven or Aghada. On each of these the single fare will be 10 cts. for first and second-class and 6 cts. for third-class. The return tickets will be double those for the single journey, and intermediate stations will be charged the same as the terminals. The company claims that the new system will enable it to deal satisfactorily with the great rush of summer traffic, as, instead of 150 different sorts of tickets now issued at the Cork station, there will in future be only eight, while the new scale of fares will be 30 per cent. lower. English papers speak of this as an application of the zone system, but it is more properly an approach to the American system of uniform fares.

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THE CARTAGENA TERMINAL & IMPROVEMENT CO. has been organized under the laws of West Virginia to acquire certain concessions granted by the United States of Colombia. A narrow gage railway is being built between Cartagena and the Magdalena River, a distance of 52 miles, and the company has exclusive rights for 39 years for wharves, warehouses, steam tugs and lighters in the port of Cartagena. The Magdalena River is navigated for 650 miles, but is impassable at the mouth owing to the existence of shifting sand bars. Reports on the railway and other works have been made by Col. S. H. LOCKETT and Mr. J. M. TOBIAS, and the cost is estimated at $687,000 for the railways and stations, etc.; $100,000 for equipment and $100,000 for wharves and warehouses. Among the directors of the company are Gen. E. P. ALEXANDER, President Georgia Central Railroad & Banking Co.; J. MURRAY FORBES, President Chicago, Burlington & Northern R. R. Co., Boston; Hon. T. JEFFERSON COOLIDGE, Boston; Mr. S. B. MCCONNICO, New York, and Mr. JAMES C. COLGATE, New York.

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SOME MAGNETIC ANOMALIES IN RUSSIA, have been determined by Gen. ALEXIS DE TILLO, for the Imperial Russian Geographical Society in a restricted area between the cities of Charkov and Koorsk. Within this area, and within intervals not exceeding 12 kilos, the declination of the magnetic needle changes 86° and the inclination 29°. Thus, at Nepchævo the declination is 48° W., while at the comparatively near village of Kisselvo it is 38° E. The horizontal intensity near Kisselvo is 0.38 and the total 0.75 in electrical units. How extraordinary these observed values are may be inferred from the fact that the normal values for the region explored are E. 1° only for the magnetic declination, 64° for the inclination, for the horizontal intensity 0.21 and for the total intensity 0.48. There is an oval area in Siberia presenting some like anomalies. In the interior of the Siberian oval the needle's declination is 5° W., gradually decreasing to zero around the edge of the anomalous area, beyond which, as far as the Caspian agonic line, the declination is E. Similar anomalies were discovered in the British Isles in the summer of 1889 by Professors RUCKER and THORPE, but these eccentricities are closely connected with the geology of the district through which they run, while those in Russia appear to be inexplicable by the geological constitution of the soil.

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STATION INDICATORS, operated by the conductor, have been introduced on the electric City & South London Ry., England. According to report the indicators in all the cars are operated by one handle. A station indicator which is being introduced on the Grand Trunk Ry., Canada, in which the indicator of each car is independent and worked by the brakeman, was described in ENGINEERING NEWS, Feb. 14, 1891.

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A SHAY GEARED LOCOMOTIVE, weighing 90 tons, built for the Montana Union R. R. by the Lima Machine Works, Lima, O., has been in operation for 3 months on grades of 164 ft. to 211 ft. per mile, and is said to give good satisfaction. A description of this type of engine was given in ENGINEERING NEWS, April 26, 1890.

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THE MELVILLE IRRIGATION act bids fair to help irrigation in South Dakota in as marked a way as the Wright irrigation act in California. The former bill was passed by the last legislature, and provides that upon petition of at least 20 property owners within a township, the State Irrigation Engineer shall examine the township for sites for artesian wells. If the engineer approves, the township may issue bonds to pay the cost of constructing not more than 9 6-in. or 16 4-in. wells, located by the engineer with a view to their success as wells and their availability for irrigating the lands of the township. It is said that the bonds sell readily, owing to the confidence in the success of artesian wells in the state, and the fact that the townships are limited to an issue of 5% of their assessed valuation. Mr. J. H. BALDWIN, of St. Lawrence, is State Engineer. He has already located 18 wells, and is reported by the St. Paul *Pioneer-Press* as saying that before winter he expects to locate 200 more.

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## CONSTRUCTION NEWS.

### RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

***Little Falls & Dolgeville.***—This company has filed articles of incorporation with the Secretary of New York State. The road is to run from Little Falls to Dolgeville N. Y., about 12 miles. Contracts have been let, and work will begin at once. Warren H. Loss, 10 Wall St., New York City, President.

***Wellsville, Coudersport & Pine Creek.***—An effort is being made to have this company extend its road from Wellsville to Belfast, N. Y.

***Pittsburg, Ohio Valley & Cincinnati.***—It is reported that this company, which has under construction a line from Bellaire to Marietta, O., 75 miles, will abandon its proposed route between Powhatan and Marietta, and run from Powhatan, via Woodsfield and McConnellsville, toward Cincinnati, O.

***Lancaster, Oxford & Southern.***—It is stated that construction will soon begin on this Pennsylvania railway. The company proposes to build lines from Quarryville, Pa., to White Rock, Pa., 9 miles, and from Oxford, Pa., to Singerly, Md., 14 miles, connecting the Philadelphia & Reading R. R. and the Baltimore & Ohio R. R. S. C. Slaymaker, Lancaster, is Chief Engineer.

***Concord & Montreal.***—The New Hampshire Legislature has passed the bill authorizing this company to increase its capital stock $3,000,000. The proceeds are to be used for the purpose of aiding an extension of the Whitefield & Jefferson R. R., and of such other branches as it may be authorized to construct, and for the purpose of providing additional depots, yards and other terminal facilities at Nashua, Manchester, Portsmouth, Concord, Laconia, Lake Village and elsewhere; of providing additional tracks, wharves and coal and other storage facilities at Portsmouth; of changing the line and improving the te

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* The manufacturers explain the motive for the omission of the copper coil and the change in the smoke-bell as follows:

We found in practice that there was no perceptible advantage to be gained by the use of the copper coil, owing to the fact that the hot air would not travel any great distance before it had lost all the heat given to it in passing through the coil, and we disposed of its use for this reason, and also because it reduces the cost of manufacture. At the same time we are putting it in all the carbureters for the Pennsylvania R. R. and auxiliary lines, as they desire it as their standard, and we have no objection to its use. With our new style of inverted lamp the heat does not strike this copper coil as direct as it otherwise did with the old argand burner, consequently we gained nothing by its use, and we disposed of its use in February, 1890, when we adopted the inverted regenerative lamp as our standard.

In regard to changing the smoke-bell and introducing a perforated plate, it was necessary to make this change in order to prevent the lights from being blown out, caused by either an excessive upward or downward draft through the ventilator flue, which was generally caused by the opening of doors before the train stopped, and then by the sudden application of the air brake by the engineer when he found that he was running past the station, and the brakes were not released until after the train had come to a standstill, thus causing a sudden suction, and the improved perforated plate or smoke-bell prevented, to a great extent, the extinguishing of the lights under these circumstances; it also diverted more of the heat around the carbureter, which was a very good feature, as it keeps it at a more even temperature.

We have made no change in the by-pass opening [which is ⅜ in.—ED.]. In regard to contracting the exit for hot air through the ventilator we reduced the height of the ventilator owing to the fact that with the old style the carbureter measured 12 ins. high over all. This height was so great that we could not apply it to ordinary cars in the West, owing to the limited clearances, and also because of limited clearances in the New England states. The openings through this carbureter are from 13 to 15 times greater than the flue of the lamp; we have even gone further than this, and in some cases reduced the height of the ventilator to 1¼ ins. above the carbureter as compared with the 6-in. ventilator first designed by the Pennsylvania R. R. Co.

In making these changes we have always endeavored to have from three to four times the opening in the ventilator that we have in the lamp chimney, and this, we think, is sufficient to take care of all heat from the cars. We have also made this change in the ventilator openings owing to the fact that the Western roads complained that the openings were so large in the old-style ventilator that there was a reverse draft downward through the flue which was very annoying to passengers, and cooled off the car excessively in cold weather. All of these improvements that we have made in the system since its adoption have been greatly to its advantage, and it has made the system applicable to all styles and classes of cars for all roads. The changes are never made hastily by us, and are only decided upon after very careful consideration and thorough practical test.

* The older styles of lamps only were put out in this way, we are informed. The new inverted lamp is only caused to flicker or jump by this cause, but never goes out.

minal facilities at Groveton Village, and for providing additional equipment and for the improvement of its railroad and other property owned or leased by it.

***Pittsburg, Akron & Western.***—Surveys are reported in progress for an extension from Akron, O., via Mogadore, to Youngstown, O., about 50 miles.

***Portland & Rumford Falls.***—It is reported that construction will soon begin on the extension of this Maine road to Rumford Falls, Me. The extension will be about 14 miles long.

***Washington & Waynesburg.***—The right of way has been secured for the extension of this road from Waynesburg, Pa., south to the State line. It is hoped to induce the Pennsylvania Co. to build the line.

Projects and Surveys.

***Adirondack Extension.***—Chartered in New York to build a railway from North Lake to Malone, N. Y., about 120 miles. The company is probably in the interest of the Delaware & Hudson Canal Co.

***Georges Valley.***—The Maine Central R. R. Co. has informed the projectors of this road that it will do nothing toward its construction this season.

***Mohawk & Adirondack.***—Chartered in New York to build a railway from Poland, Herkimer Co., N. Y., to Malone, N. Y., 150 miles. The company was formed to build the extension of the Herkimer, Newport & Poland R. R., now owned by the Vanderbilts.

***Glen Hazel & Shawmut.***—Chartered in Pennsylvaina to build a railway from Ketter's Station, on the New York, Lake Erie & Western R. R. to near Daguscahonda, about 15 miles. President, S. S. Bullis, Olean, N. Y.

***Brookline.***—This company has completed its organization by the election of Franklin Worcester, Hallis, N. H., President, and J. H. S. Tucker, Brookline, N. H., Clerk and Treasurer. The surveys are to begin at once. The road is to run from Potanopo Lake, in Brookline, to the Massachusetts State line.

***Exeter & Amesbury.***—The incorporators have completed the organization of this company, and will at once take steps toward commencing construction. The road is to connect the main line of the Boston & Maine R. R. at Exeter, N. H., with the Amesbury Branch of the same road at Amesbury, Mass.

***Keystone.***—Chartered in Pennsylvania to build a railway from Gardeau, Cameron Co., to Monroe, McKean Co, Pa., 7 miles. President, H. C. Rich, Emporium, Pa.

***Brookfield & Southbridge.***—The charter has been secured and the stock subscribed for the construction of this road between Brookfield and Southbridge, Mass., 13½ miles. The surveys are completed and estimates made. A correspondent writes us that the road will probably be built. A. C. Moore, Sturbridge, Mass., is Chief Engineer.

***Greenwich & Rutland.***—Parties are again reported as engaged in securing the right of way for this line from Greenwich, N. Y., to Rutland, Vt., 56 miles.

***Mt. Carmel & Natalie.***—Construction is reported begun on this line from Mt. Carmel to Natalie, Pa., 6 miles. The work will be quite difficult.

SOUTHERN.—Existing Roads.

***Richmond & Danville.***—At a recent meeting of the directors of the North Carolina Midland R. R., it was decided to issue bonds covering the whole line of the road, and to build at once. The road is projected to run from Danville, Va., via Winston and Mocksville, N. C., to Mooresville, N. C., 125 miles. The section from Winston to Mocksville has been graded, and tracklaying is in progress. A large amount of surveying has been done on the remainder of the line.

***Charleston, Sumter & Northern.***—The extension from Sumter to Bennettsville, S. C., is now completed to Darlington, S. C., and regular trains are running.

***Augusta & West Florida.***—The reorganization of this company has been effected. C. E. Smith was elected President, and J. P. Verdery, Secretary. Construction on the first 50 miles from Augusta, Ga., south will be pushed.

***Louisville & Nashville.***—Work on the Clarksville Mineral branch is making rapid progress. The line runs from a point 8 miles west of Clarksville, Tenn., to a point 3 miles west of Dickson, Tenn., 31 miles, with a branch from Vanleer to Cumberland Furnace, 6 miles. It is expected that the line will be completed from Dickson to Cumberland Furnace in about one month, and that the entire line will be completed by July 15.

***Charleston, Cincinnati & Chicago.***—There is some probability of work being resumed on the division from Blacksville, S. C., to Augusta, Ga., in order to secure the $80,000 of bonds voted by Union Co. From Rutherfordton to Marion, N. C., work is being carried on by a small force.

Projects and Surveys.

***Broadway & West Virginia.***—F. H. Skeele, of 35 Wall St., New York City, President, writes us that this road is projected to run from Ottobine, Va., via Rawley Springs, Faulks Run, Coot's Store, Broadway, Edith P. O. and Seven Fountains to Front Royal, Va., 80 miles. About 7 miles of the line has been surveyed. Most of the right of way has been obtained gratis and about $300,000 other local aid obtained. Geo. C. Dickson, Broadway, Va., is Chief Engineer.

***Chattanooga Terminal & Suburban.***—This company has been chartered in Tennessee, supposedly for the purpose of consolidating the Chattanooga Belt and the Lookout Mt. railways.

***Unaka & Nollachucky.***—The preliminary surveys for this Tennessee railway have been completed. It is reported that work will begin soon.

***Fort Fisher Land & Improvement Co.***—Surveys for a 4½-mile railway from Carolina Beach to Fort Fisher, N. C., has been completed by this company. L. D. Cherry, Wilmington, N. C., Chief Engineer.

***Richmond Southeastern.***—A project to construct a railway from Richmond, Va., along the south bank of the James River, via Smithville and Chucatuck, to Suffolk, Va., is being agitated.

NORTHWEST.—Existing Roads.

***Duluth & Winnipeg.***—On account of the failure of the Land Grant bill to pass the last Minnesota Legislature a new financial plan will have to be adopted by this company. The road has been built thus far by individual capital. It is now proposed to issue bonds.

***Canadian Pacific.***—President Van Horne is quoted as follows in a newspaper interview:

The Canadian Pacific line is being relaid between Winnipeg and Port Arthur with new 72-lb. steel rails, and from Ottawa River westward the trestles and bridges are either being filled in with earth or replaced with stone structures. Extensive improvements are also contemplated in the mountain section during the present and coming year, and very large additions will be made to the rolling stock to provide for the rapidly increasing business of the company. Sixty locomotives and a great many freight and passenger cars are already under order. The Souris branch will be constructed this year to the Coal-fields. The company did not intend building a bridge across the Red River at Selkirk as reported. The Calgary and Edmonton Railway will probably be extended to Macleod this year.

Projects and Surveys.

***St. Louis & Northern.***—Chartered in Illinois to build a railway from Rock Island, Ill., to Havana, Ill. Among the incorporators are: Isaac L. Morrison, David W. Rider and Wm. L. Hook, all of Jacksonville, Ill.

***Sioux City & Morning Side.***—Chartered in Iowa to build a railway by this name. The officers are: President, J. A. Jackson; Vice-President, Allen Crussan; Secretary, T. C. Prescott, and Treasurer, A. S. Garrison.

***Muscatine, Rock Island & Peoria.***—Chartered in Illinois to build a line of railway from a point in Illinois, opposite Muscatine, Ia., or from Rock Island, Ill., to Peoria, Ill. Among the incorporators are: Andrew Perry of Peoria, Ill., and Geo. O. Hodge, Winona, Ill.

SOUTHWEST.—Existing Roads.

***Franklin & Abbeville.***—This Louisiana road will be extended about 4 miles this season.

***Kansas City, Watkins & Gulf.***—Work from Alexandria, La., south toward Lake Charles, has been commenced with a large force of men and teams. Tracklaying is in progress from Lake Charles north.

***Houston, Central Arkansas & Northern.***—The grading and bridge-work on the section from Columbus to Alexandria, La., will be completed in about two months.

***Omaha, Hutchinson & Gulf.***—There is talk of extending this road from its present terminus at the Kansas-Indian Territory line, across Indian Territory to Denison, Tex., this year.

***Louisiana, Arkansas & Missouri.***—Chief Engineer, W. C. Agnew, 7 Martin Block, Little Rock, Ark., will receive bids until May 18 for the construction of the division between Tripp, Ark., and Delhi, La., 81 miles. Work is to be begun at once. Surveys are now in progress from Delhi to Bryan City, La.

Projects and Surveys.

***Kansas City & Independence.***—The surveys for this suburban railway at Kansas City, Mo., have been completed, and contracts will probably be let soon. The track will be standard gage, and laid with 70-lb. steel rails. The Missouri, Kansas & Texas Trust Co. is building the line.

***Fort Gibson, Tahlequah & Great Northern.***—An official of this company is quoted as saying that surveys would begin at once. The road is projected to run from Rogers, Ark., via Siloam Springs and Tahlequah, to Fort Gibson, Ind. Ter. J. E. Crane is President.

***Rusk, New Birmingham & Dallas.***—Chartered in Texas to build a railway from New Birmingham to Rusk, Tex., and thence to a connection with the International & Great Northern Ry., between Palestine and Trout.

ROCKY MT. AND PACIFIC—Existing Roads.

***Silver City & Northern.***—T. G. Condon, Whitewater, N. Mex., Vice-President, writes as follows:

This road is projected to run from Whitewater, N. Mex., on the Atchison, Topeka & Santa Fé R. R. to to Georgetown, N. Mex., 19 miles. The route is through a quite rough country. The maximum grade will be 3% and the minimum curve 12°. There will be some heavy bridging. The contract has been let to local contractors who now have about 60 teams and 100 men at work. Ten miles of the grading have been completed and tracklaying has begun. It is expected to have the line complete by July 1. J. B. Gilchrist, of Whitewater, is Chief Engineer.

***Northern Pacific.***—Assistant Engineer Burke is quoted as follows in a recent interview:

The Western Division, which includes everything from Hope, Idaho, west, is now receiving some $10,000,000 worth of improvements and extensions. The work is scattered over all parts of the division, and includes the Cœur d'Alene district, the Spokane yards and depot, the Central Washington extension to Coulee City, the Stampede tunnel, which is being arched with brick, supported by concrete wall; the Seattle improvements, the Lake Washington belt line work and the Green River and northern extension, the Gray's harbor and Willapa harbor work and the car shops at Edison, south of this city. Just at present work at Seattle is tied up, owing to litigation, but much remains to be done in that city. The Stampede tunnel work progresses slowly, as the movement of trains interferes. The cost of building the concrete walls and arching the tunnel with brick is about $75 per foot. Of the two miles of tunnel there are only 600 ft. of good tunnel rock—that is, rock that does not have to be arched to support it. The timber must be removed, as its life is exhausted, and rather than put in another timber arch support, the company goes to the greater expense of putting in concrete and brick, which will prove a permanent improvement.

About 500 men will be put at work on the line from Chehalis to South Bend, Wash., 54 miles, and the road rapidly completed.——About 300 men are at work between Ocastar and South Aberdeen, Wash.——Construction will be resumed on the Green River & Northern R. R. in June, and it will be completed to the Niblock coal mines by Jan. 1, 1892. The extension is 18 miles long, and will cost about $2,000,000.

***Rogue River Valley.***—A project is on foot to extend this road to Eagle Point, Ore. It is proposed to use the Southern Pacific tracks from Medford, Ore., to Central Point, Ore., and to build from Central Point to Eagle Point, 12 miles. The road is now in operation between Medford and Jacksonville, Ore.

***Port Townsend Southern.***—Grading has been completed to Quilicene, Wash., and tracklaying will begin at once. About one-half of the rails are on the ground. The preliminary survey for the line from Olympia to Hoods Canal will begin at once.

***Great Northern.***—Press reports state that this company has decided to cross the Cascade Mountains by the Nachez Pass.——A branch from Butte City to Anaconda, Mont., 26 miles, is under consideration.——The contracts for the Barker extension, 11½ miles, have been let and work is in progress.——Work on the Seattle & Montana R. R. is delayed by the non-arrival of the rails. The grading has been completed and the bridge-work is far advanced as is possible until the track is laid.

***Southern Pacific.***—There is a report that work will soon be commenced on the line from Ellwood to San Luis Obispo, Cal.

***Burlington & Missouri River.***—Grading will soon be resumed on the extension from Newcastle, Wyo. The road is now completed to Merino, Wyo., and about 80 miles from that place northwest has been graded with the exception of surfacing. It is intended to lay the track on this grade at once.—A press dispatch from Cheyenne, Wyo., says that Kilpatrick Bros. & Collins have made an offer to this company to build a line from Alliance, Neb., to Cheyenne, Wyo., and thence to Denver, Colo., about 240 miles, taking a second mortgage on the line in payment for the cost of construction. The proposition is being considered.—Arrangements are reported completed for building the proposed line from De Witt, Neb., via Fairbury to Omaha and Lincoln, Neb.

***Rio Grande Southern.***—Tracklaying, which was completed last year from Dallas to Telluride, Colo., will be resumed at once from the latter place south. It is expected to have the line completed to Rico by Aug. 15.

***Coos Bay, Roseburg & Eastern.***—Arrangements are being made to push the work from Marshfield, Ore., to Myrtle Point, which has been delayed by wet weather. It is expected to begin work on the draw-bridge over Isthmus Slough soon, and when this is completed to lay the track. It is hoped to have the above section in operation by Aug. 1. Engineers are locating the line between Myrtle Point and Roseburg, Ore. About 450 men are now at work and the force is being increased.

Projects and Surveys.

***New Mexico.***—It is stated that S. M. Rowe has resigned his position as Chief Engineer of the Atlantic & Pacific R. R., and is engaged in locating a narrow-guage railway from Coolidge, N. Mex., south into the Zuni Mountains. The length of the road and its branches will be about 100 miles.

***The Dalles Portage.***—This company has been organized to build the proposed railway around the Dalles of the Columbia River, in Oregon, mentioned in our issue of April 25. The road will run from a point near the eastern boundary of The Dalles City to a point on the Columbia River near the mouth of Spanish Hollow, Sherman Co., Ore.

## CITY TRANSIT.

**Electric Railways.**—New lines or extensions of existing systems are reported as probable in the following places: Santa Cruz, Cal., address E. H. Robinson; Port Townsend, Wash., address J. A. Potter, of Fidalgo; Nashville, Tenn., address the High Street Electric R. R. Co.; Bay Ridge, Md., address the Bay Ridge Electric R. R. Co.; Burnt Mills, Md., address Waters & Mannaker; Woonsocket R. I., address the Woonsocket Street Ry. Co., Whatcom, Wash.; Duluth, Minn., address the Duluth Street Ry. Co.; Kansas City, Mo.; Denver, Col., address the Denver & Suburban Ry. Co.; San Francisco, Cal., address J. C. Stump; Baltimore, Md., address the Park Tramway Co.; Buffalo, N. Y., address the Buffalo Ry. Co.

***Brooklyn, N. Y.***—The stockholders of the Brooklyn City R. R. Co. have voted to issue $6,000,000 of bonds to

redeem outstanding bonds and meet the expense of introducing electricity.

*Scranton, Pa.*—In a recent fire here, the barn and 29 electric cars of the People's Street Ry. were destroyed, resulting in an estimated loss of $60,000.

*Towson, Md.*—The County Commissioners have granted permission to the Pimlico & Pikesville R. R. Co. to adopt electricity on its lines.

*Raleigh, N. C.*—The electric railway question here has been apparently settled by the aldermen and bondholders, the latter having agreed to complete the system by August.

*Vincennes, Ind.*—The Citizens' Street Ry. will be extended several miles and all the track put in condition for the electric cars, which will be run soon.

*Detroit, Mich.*—The franchise of the Detroit & Suburban Ry., an electric line, will, it is said, be reported favorably to the City Council.

*Eugene, Ore.*—H. W. Hodden has been granted a franchise to build a 3-mile line.

*Puyallup, Wash.*—It is reported that F. C. Ross, of Tacoma, will build a line to that place. The line will be standard gage, and connect at Puyallup with a proposed dummy line to Sumner.

**Dummy Railway.**—*Tres Pinos, Cal.*—J. J. Burt has secured right of way for a line through Paicines to Lime Kilns.

**Horse Railways.**—New lines or extensions are reported as probable in the following places: Milford, Mass.; Lewiston, Me., address the Lewiston and Auburn Street Ry. Co.; Sheffield, Ala., address T. D. Radcliffe; Baltimore, Md., address the North Baltimore Passenger Ry. Co.; Long Island City, N. Y., address the Long Island City & Newtown R. R. Co.; Santa Rosa, Cal., address J. W. Farnham.

*Toronto, Ont.*—The Committee on Street Railway Affairs has decided to readvertise for bids for the railway until May 20.

*Santa Rosa, Cal.*—The stock of the North Side Street Ry. has been all taken up and work will probably soon begin on the proposed line.

**Cable Railways.**—*New York, N. Y.* It is reported that the Sixth Ave. R. R. Co., the Forty-second St., Manhattanville & St. Nicholas Ave. Ry. Co., and the Fifty-ninth St. branch of the Central Park, North & East Rivers R. R. Co. all contemplate applying for permission to operate all or part of their lines by cable.

**Elevated Railway.**—*Philadelphia, Pa.*—Mayor Stuart will receive bids until June 15, for the construction of a double-track elevated line on Market St.

**New Companies.**—Ducktown (Ky.) Belt R. R. Co.; incorporators, J. W. Savlor, E. C. Lucky, E. T. Sanford and others. Weems Electric Ry. System Co., New York; capital stock, $2,500,000; President, O. J. Smith; Vice-President, D. G. Weems; Secretary, W. B. Stowe; offices, 32 Vesey St. Houston (Tex.) Rapid Transit R. R. Co.; capital stock, $300 000; incorporators, J. T. Wilson, J. A. Patton, H. J. Wilson. Capital Ry. Co., Albany, N. Y.; capital stock, $10,000; incorporaters, A. Hessberg, H. Bronk, R. Bryce, and others. International Electric Ry. Co., Chicago, Ill.; capital stock, $2,000,000; incorporators, J. J. Hanna, D. L. Coe, M. M. Wood. New York & South Beach Ry. Co., Arrochar, Staten Island, N. Y.; capital stock, $150,000; directors, F. H. Steele, of Brooklyn; D. G. Thompson and S. H. Gurter, of New York, and others; length of proposed line is 3 miles. Central Electric Ry. Co., Sacramento, Cal.; capital stock, $500,000; incorporators, J. H. and W. E. Henry, J. P. Burke and others.

## HIGHWAYS.

*Pennsylvania.*—Upper Darby township has voted in favor of raising a loan of $150,000 for improved roads. The farmers of North Coventry, Chester Co., have ceased holding public meetings relative to the proposed new road law, and under the direction of Road Supervisor Bell have set to work to improve their highways by mutual efforts.

*Michigan.*—The Board of Supervisors of Saginaw Co. met in special session April 29 and elected John W. Messner, of Bridgeport, as Chairman. Stone road commissioners were elected, and it is the intention to commence work as soon as practicable, and give the county as good stone roads as can be found in the state. An appropriation of $100,000 has been voted.

*Maryland.*—A new road is being opened from Hyattsville westward to the Vansville road. A bridge will be constructed across the Eastern Branch, and the expenses of the work will be paid by voluntary subscription. The land and the right of way for the road have already been given by the property owners. The contract for a new road near Adamstown has been awarded to J. A. Barrick of New Medway, Frederick Co.

*British Columbia.*—The government builds and repairs the wagon roads. On low or soft ground they first lay a foundation of cedar or other substantial corduroy and dig ditches on either side, using the dirt to cover the corduroy.

## BRIDGES, TUNNELS AND CANALS.

**Bridges.**—*Cleveland, O.*—The bill authorizing this city to issue $200,000 of bonds for bridge building has passed the Ohio State Senate.

*Rensselaer Co., N. Y.*—David Newkirk, of Couse, Rensalaer Co., N. Y., will receive bids for the construction of a stone bridge until May 16.

*Ravenswood, W. Va.*—Bids will soon be asked for building a bridge over the Poca River near this place. It will be 300 ft. long, with a 40-ft. roadway.

*Atlanta, Ga.*—Bids for the Forsyth St. bridge will be received until June 15. R. M. Clayton, City Engineer.

*Little Rock, Ark.*—A. J. Tulloch, proprietor and engineer of the Missouri Valley Bridge and Iron Works, of Leavenworth, Kan., has been awarded the contract for a large steel bridge over the Arkansas River at this place. It is to be 50 ft. above high water, and will rest on masonry piers placed in position by the pneumatic process. The entire work is to cost $275,000.

**Tunnel.**—Senator Howland, of the New Brunswick Legislature, is pushing a scheme for building a tunnel under the Straits of Northumberland between Bayfield Head, N. B., and Augusta Cove, P. E. I. The tunnel would be about 11 miles long.

## WATER-WORKS.

### NEW ENGLAND.

*Freeport, Me.*—Works are projected, and a vote on the question will be taken May 9. It is proposed to pump from a pond to a stand-pipe. Address E. B. Mallet.

*Goffstown, N. H.*—S. D. Upton and J. H. Connor are among the recently elected water commissioners to construct new works.

*Lowell, Mass.*—The engine-house will be enlarged and bids are wanted.

*New Bedford, Mass.*—A 20-in. main is to be laid in County St. between South and River Sts.

*Providence, R. I.*—The Senate has passed in concurrence an act authorizing the city to issue $500,000 water extension bonds.

*Terryville, Conn.*—Works are being built by the Terryville Water Co.

*Meriden, Conn.*—Only two bids were received for the construction of the reservoir, and as these were but $800 apart in price, the committee rejected them and decided to advertise in engineering papers. An advertisement appeared in this journal last week. Bids will be opened to-day.

### MIDDLE.

*Batavia, N. Y.*—On May 8 the Aldermen were to consider the proposition of stockholders of the Michigan Pipe Co., Bay City, Mich., to put in works estimated to cost $50.000. The parties interested propose to organize a company.

*Brooklyn, N. Y.*—The Court of Appeals on May 5 affirmed the order of the lower court restraining the Mayor, Comptroller and Auditor of Brooklyn from purchasing the property of the Long Island Water Supply Co.

*Huntington, N. Y.*—A franchise has been granted to the Huntington Water-Works Co. for works within the Union School District. Water will be pumped from wells to a 250 000-gall. reservoir or stand-pipe with its high-water line 120 ft. above the main street. There will be about 4½ miles of mains and 35 hydrants. James M. Brush is President, and Joseph Irwin, Secretary of the company. G. R. Rogers is Town Clerk.

*Polsdam, N. Y.*—W. F. P. Sealy, Superintendent, informs us that plans are wanted for heating the pump-house by steam from boilers already placed.

*Rochester, N. Y.*—It is reported that $50,000 will be asked for water main extensions this year.

*Syracuse, N. Y.*—The introduction by the city of water from Skaneateles Lake has been again postponed, this time by a decision of the Supreme Court that the legislative acts giving permission to take the water are invalid. The case will probably be carried to the Court of Appeals. The company's plant is now being appraised to determine the price to be paid for it by the city.

*Warwick, N. Y.*—W. A. Hulse, Commissioner, informs us that $15,000 of bonds were recently voted for a new reservoir.

*Whitestone, N. Y.*—A resident informs us that the works noted last week will include a supply pumped from wells to a stand-pipe; that G. A. Roullier is Engineer, and that the population is 3,500.

*Yorkshire Centre, N. Y.*—The Yorkshire Water Co. has been organized. G. N. Cowan, Stamford, is interested.

*Maple Shade, N. J.*—It is reported that works will be built by the Maple Shade Land Co.

*Ocean City, N. J.*—It is reported that works are to be built here.

*Somerville, N. J.*—W. H. Taylor, Secretary, informs us that a 1,000,000-gall. steam pumping engine will be added.

*Altoona, Pa.*—The agitation regarding an increased water supply continues, but we are informed that the proposition will probably be voted down.

*Beaver Falls, Pa.*—It is reported that works for their own use will be put in by Carnegie, Phipps & Co.

*Latrobe, Pa.*—W. A. Johnston, Superintendent, informs us that arrangements are being made to build a new reservoir and pump-house and to lay about 2¼ miles of 16-in. mains.

*Oil City, Pa.*—The annual contract for pipe has been awarded to R. D. Wood & Co., Philadelphia, and for valves and hydrants to the Eddy Valve Co., Troy, N. Y.

*South Bethlehem, Pa.*—B. E. Lehman, Superintendent, informs us that the contract for the new 10,000,000-gall. reservoir, bids for which were asked in this journal, has been awarded to T. F. Kerns, Pottsville, Pa.

*Washington, Pa.*—J. Mac Jones, Superintendent, informs us that the company proposes to build another dam and reservoir and put in a new filter.

*Weaver's Old Stand, Pa.*—It is reported that the Frick Coke Co. proposes to build a reservoir to supply their works.

*Yorkville, Pa. (Pottsville).*—C. R. Kear, Secretary of the Minersville Water Co., informs us that the borough of Yorkville will lay mains to the borough line to connect with the company's works.

*Milford, Del.*—The following is from P. W. Marshall, Secretary:

Bonds to the amount of $40,000 have been voted for water-works and electric lights, the vote being 1,153 to 101. The Light and Water Commissioners wish to engage an engineer to prepare plans and specifications for works. Nathan Pratt is President of the Board.

### SOUTHERN.

*Parkersburg, W. Va.*—The following is from S. F. Shaw:

The Spring Brook Water Co. is being formed to supply Elberon and Riverside, places with a population of 2,000. The supply will be from springs one mile distant, and the works are estimated to cost $20,000. Address the above, or Z. F. Taylor.

*Fayette, N. C.*—It is reported that new works will be built by the National Water Supply & Guarantee Co., Ashland, Ky. Small works have been in operation since 1829.

*Carrollton, Ga.*—It is reported that a franchise for works has been granted. See note in last week's issue.

*Madison, Ga.*—E. W. Butler, Mayor, informs us that a franchise has been granted to W. A. Robinson, Atlanta, Ga. The town will take 50 hydrants.

*Rome, Ga.*—It is reported that the supply will be increased.

*Tallahassee, Fla.*—The Tallahassee Pressed Brick Co. wishes to buy 8,000 ft. of 1½-in. pipe.

*Attalla, Ala.*—Hartford, Hebert & Co., Chattanooga, Tenn., Engineers for the works, have sent the following:

Construction of city works estimated to cost $30,000 will be started May 15. Water will be pumped from springs to stand-pipe. Population about 2,000.

*Sheffield, Ala.*—J. V. Allen, Secretary, informs us that the company expects to issue bonds to enlarge the works.

*Sequachee, Tenn.*—The following is from T. H. Hill, Secretary, Sequachee Town & Improvement Co.:

The company has let a contract for works to G. Sherman, Sequachee. The source of supply is springs in the Cumberland Mountains, about one mile from, and 400 ft. above the village. About 2½ miles of pipe, mostly 2 in., has been laid for temporary use. Population, 350.

*Union City, Tenn.*—S. Waddell, Mayor, informs us that the people have voted $60,000 in bonds for water-works and electric lights. The bonds will be sold and contracts let as soon as possible. An engineer may be engaged by the city.

### NORTH CENTRAL.

*Dayton, O.*—The House bill authorizing $50,000 of bonds to extend water mains has passed the Senate.

*Bridgeport, O.*—The Mayor and City Clerk of Martin's Ferry have been authorized to sign a contract to furnish water to Bridgeport.

*Put-in-Bay, O.*—The Put-in-Bay Water-Works, Light & Railway Co. have been incorporated by Toledo capitalists; capital, $150,000.

*Zanesville, O.*—The pumping engine at the Fourth St. station broke down May 2.

*Delphi, Ind.*—The Delphi Water-Works Co. has been incorporated; capital, $5,000.

*Zionsville, Ind.*—It is reported that contracts for works have been made.

*Fowlerville, Mich.*—An act authorizing bonds for works has passed the House.

*Greenville, Mich.*—J. Gracey, Superintendent, informs us that a well 25 ft. in diameter and 18 ft. deep is under consideration.

*Sparta, Mich.*—The Sparta Water Co. has been organized by L. W. Welch, A. B. Cheney and others. A stand-pipe is proposed.

*Dundee, Ill.*—The Dundee Water Co. has been incorporated; capital, $10,000.

*Metropolis, Ill.*—F. A. Trousdale informs us that the people have voted, by a large majority, in favor of water-works and electric lights. Pipe will be bought from the Massoc Iron Co., of Metropolis. Address the above.

*Burlington, Wis.*—The village has sold $8,000 of water bonds and the mains will be extended.

*West Superior, Wis.*—J. Mather, Manager, informs us that the company will probably buy an additional pump this year with a capacity of 5,000,000 galls. The kind of pump has not yet been determined.

### NORTHWESTERN.

*Council Bluffs, Ia.*—The Greenwood Water Co. has been incorporated by D. N. Graves, J. H. Kent and others. The company propose to supply the Wilson Terrace, Oak Grove and Greenwood additions.

***New Hampton, Ia.***—A contract for works has been let.

***Sioux City, Ia.***—Mains have been ordered on several streets.

***Minnesota.***—We are informed that Luverne, Tracy & Worthington have had plans prepared for works and will soon ask for bids.

***Ponca, Neb.***—The following is from S. B. Stough, City Engineer:

Bonds for works estimated to cost $10,000 have been voted, and plans will be ready as soon as the bonds are sold. Water will be pumped from wells to a reservoir about 140 ft. above wells, and will be used more especially for domestic purposes. It is probable that contracts will be let about June 10. Population, 1,200.

***Hill City, S. Dak.***—A gravity supply of water from Newton's Fork, some miles distant, is under discussion. The plan includes a reservoir. W. H. Mitchell is President, and D. H. Nourse Recording Secretary of the Board of Trade.

***Rawlins, Wyo.***—H. Rasmusson, Mayor, informs us that $35,000 of bonds will be sold May 11, the proceeds to be used for the enlargement of the works.

### SOUTHWESTERN.

***Butler, Mo.***—The Butler Water, Light & Power Co. has been incorporated; capital, $100,000.

***Kansas City, Mo.***—The people have voted $2,000,000 of bonds for works. The contract with the National Water-Works Co. expires in 1893, and it is reported that the city must then either make a new contract with the company or buy its works. Benjamin Holmes is Mayor, and the Board of Public Works will have charge of the city works, should they be established.

***Arkadelphia, Ark.***—It is reported that contracts for the construction of works have been let. E. N. Maxwell, Secretary, Texarkana, recently informed us that works would be built here by the Arkadelphia Water & Light Co., and that water would be pumped to a stand-pipe.

***Helena, Ark.***—Bids for a franchise will be received until May 26.

***Amarillo, Tex.***—It is reported that the contract for a stand-pipe has been let.

***Brownwood, Tex.***—It is reported that the Brownwood Improvement Co. will put in water-works and an electric lighting plant. The town built works in 1887.

***Dallas, Tex.***—Bids for a 10,000,000-gall. pumping engine, will be received until May 20 by City Engineer D. A. Rayner.

***Galveston, Tex.***—The Council has authorized the issuance of $1,240,000 in bonds, as empowered by the Legislature, and the bonds have been ordered printed. A large part of the bonds will be used for water-works improvements.

***Hallettsville, Tex.***—G. Jaeger, Engineer and contractor, Rich Hill, Mo., informs us that works will be put in operation about May 15.

***Rockdale, Tex.***—A contract has been closed with Eastern parties represented by P. Kelley. Estimated cost, $42,000.

***Pasco, Wash.***—Contracts have been let for a tank and for pipe.

***Spokane Falls, Wash.***—The people will vote on the issuance of $1,200,000 of bonds, of which $500,000 are for water-works improvements.

***Rockford, Wash.***—Estimates for constructing city water-works have been submitted by the West Coast Engineering Co., Seattle, and Parke & Lacy, Spokane Falls. It is reported as probable that the contract will be awarded to the latter as soon as bonds are voted.

***Ruby City, Wash.***—The Water, Light & Power Co. has been incorporated; capital, $100,000.

***Rocklin, Cal.***—It is reported that the South Yuba Water Co. has made arrangements to introduce water here, and that a reservoir will be built on Antelope Ridge, 150 ft. above the village.

### CANADA.

***Dartmouth, N. S.***—Works have been projected here for two or three years, or more. Last year a proposition to issue $100,000 of bonds for works was defeated and the matter postponed one year. A. C. Johnston has sent the following regarding the project as it now stands:

The town hopes to issue bonds for works and to let contracts in about eight weeks. The proposed supply is from Lamont and Topsail Lakes by gravity through a 12-in. main about three miles long. Estimated cost, $70,000. F. Scarfe, J. H. Austin or the above may be addressed. Population about 4,500.

***Varennes, P. Q.***—Gaspard Lercux and Joseph A. Morin propose to build an aqueduct and supply Varennes under the partnership name of Morin & Co.

***Lindsay, Ont.***—The following is from Fred Knowlson:

An offer to construct works on the franchise plan has been made by John Galt, Toronto, and recommended to the Council for acceptance. The proposed works include artesian wells, pumps, stand-pipe, 7 miles of 14 to 4-in. mains and 80 hydrants. Estimated cost, $70,000. Population, in the whole town, 7,000. T. Walters is Chairman of the Water Committee. [A small fire protection system has been in use since 1874.—ED.]

## ARTESIAN WELLS.

***Middletown, Conn.***—An artesian well is being sunk by Marsh & Hempstead, of Cromwell, for George A. Cheney, South Main St.

***Albany, Ga.***—The eleventh artesian well, this one sunk by the Albany Brick Co., struck water at 595 ft. on May 1. Two other wells are being sunk in the city.

***Rome, Ga.***—There is talk of sinking two wells to increase the city water supply.

***Webster, S. Dak.***—Bonds for a well have been voted.

***Clarksville, Tex.***—A well is to be sunk by several citizens, jointly.

***Coupeville, Wash.***—A well is being sunk for T. Kohne. If it is a success, probably others will put down wells.

***Paris, Cal.***—A well is being sunk for hot water impregnated with sulphur, with McCarty & Fry as contractors.

## IRRIGATION.

***Logan, Kan.***—The Ward Irrigation Co. has been chartered with a capital of $24,000. A. H. Ellis, Beloit, is President, and W. A. Reeder, Logan, Secretary. A ditch will be constructed, beginning near Densmore.

***Culbertson, Neb.***—It is reported that a ditch will soon be opened here which will irrigate 100,000 acres.

***Douglas Co., Col.***—The Washington Park & Reservoir Co. has been incorporated by William R. Everett, W. E. Grey and H. S. Parse; capital, $300,000. The principal object of the company is to construct a ditch from Indian to Willow Creek, this county.

***Grand Junction, Col.***—The Council has been petitioned to appropriate $1,500 toward preliminary surveys for the Mesa Co. state ditch.

***Pasco, Wash.***—The Pasco Irrigation District is considering the practicability of constructing a ditch from the Palouse River, 65 miles long, to irrigate 100,000 acres. A company was recently formed to operate in this locality, and talks of joining the work of the district.

***Pendleton, Ore.***—The Valley Irrigation Co., recently formed, proposes to convey water from the Umatilla River, above the town, to the bottom lands of Wild Horse Creek.

***Buchanan, Cal.***—J. C. Kirkpatrick, Superintendent of the Sharon estate, proposes to dam the Chowchilla River, and build a canal and a reservoir to irrigate the ranch belonging to the estate, which includes 40,000 acres.

***San Dimas, Cal.***—The dam in connection with the project noted last week, it is reported, will be 50 ft. long at the base, 500 ft. at the top, 560 ft. wide at the base, and 133 ft. high. It is also stated that one mile east of the dam water in the reservoir will be 40 ft. deep.

***Salt Lake City, Utah.***—The Dry Creek Reservoir & Irrigation Co. has filed articles of incorporation; capital, $50,000. The company proposes to irrigate lands near Dry Creek, in Salt Lake Co. William Fairbourne is President, D. O. Rideout, Secretary, and James Mickleson, Treasurer.

**New Companies.**—Townsend Land & Irrigation Co., Townsend, Mont.; $500,000; operate in Meagher Co.; incorporators, W. E. Tierney, H. S. Hyatt, J. B. Marks. Midway Canal & Reservoir Co., Julesburg, Col.; $100,000; operate in Sedgwick Co. Big Sandy and Eureka Creek Land & Water Co., Sheridan Lake, Col.; $175,000; operate in Kiowa Co. Panoche Land & Water Co., Fresno, Cal; $200,000. Lone Pine Canal Co., Independence, Cal.; $50,000.

## SEWERAGE AND MUNICIPAL.

**Sewers.**—***Maine.***—Bangor. A considerable amount of sewer work is projected.

***Massachusetts.***—Everett. The cost of the new sewer is estimated at $300,000. Work is now in progress.—Middleboro. Mr. P. M. Blake, of Boston, has been consulted as to the sewerage and sewage disposal.

***Connecticut.***—Meriden. The special sewer committee will visit South Framingham, Mass., and other places to examine the methods of sewage disposal.—West Haven. Surveys for surface drainage are being made by the engineer, Mr. Gorham.

***New York.***—Rochester. An act has been passed providing for the construction of a sewer in the 9th and 15th Wards, and in the towns of Gates and Chili, Monroe Co.—Sandy Hill. A sewerage system is contemplated.—Port Jervis. The sewer commissioners have engaged Mr. Wm. B. Landreth, of Schenectady, to prepare plans for a system of sewerage.

***New Jersey.***—Passaic. The City Council intends to lay that part of the Waring system of sewers, having its outlet into the Passaic River. It will be of vitrified pipe, with 10 in. iron pipe for the outlet.—Orange. The Common Council has approved the contract with Mr C. P. Bassett to superintend all the sewerage contracts.

***Pennsylvania.***—Lansdown. An engineer has been investigating the question of sewerage, and estimates the cost at about $20,000 to $35,000. A large sewer would be built to Darby Creek.—Philadelphia. It is proposed to spend $400,000 on main sewers, $150,000 for branch sewers at Chestnut Hill and Mt. Airy, $25,000 for Wingohocking sewer, $75,000 for Mill Creek sewer, $50 for Aramingo Canal sewer.—Germantown. A branch sewer is to be built to drain the west side.

***Maryland.***—Baltimore. The council has authorized the expenditure of $11,000 for the Ann and Gay St. sewers and $190,000 for Druid Hill sewer.

***Kentucky.***—Covington. It is proposed to build a sewer in Willow Run at a cost of $125,000.

***Ohio.***—Ashtabula. A sewerage system is to be constructed.

***Indiana.***—South Bend. A trunk sewer is proposed for the First Ward, and it is proposed to convert the Chapin Creek into a sewer.

***Illinois.***—Cicero. Ditches are to be constructed to drain surface water into the Robinson Ave. sewer until the new sewerage system is completed.—Jerseyville. A gravity system of sewerage is to be established and part of it to be put in operation this year. No surface water will be discharged into the sewers, but they will be flushed by roof water and water from city mains. The sewage will be discharged into ravines outside the city limits, the rainfall being depended upon to wash it down these ravines.—Highland Park. The contract for the South Side sewer system in District C has been awarded to McDougall & Hammond, of Evanston, at $20,970.

***Minnesota.***—Owatonna. The council has a sewerage system under consideration.

***Washington.***—Puyallup. Plans have been prepared for a system of sewerage, and an election will be taken on the issue of bonds.

***Mississippi.***—Meridian. It is proposed to organize a company, with a capital stock of $10,000, to build sewers. For particulars address the Mayor.

**Streets.**—***Vermont.***—Rutland will spend about $4,000 on concrete roadways this year.

***Maryland.***—Baltimore. About $700,000 will be spent this year on Belgian block, asphalt block and sheet asphalt pavements.

***Ohio.***—Dayton. The White Line St. Ry. Co. will pave outside its tracks with brick or stone.

***Illinois.***—Elmhurst. An ordinance was presented at a recent meeting of the Village Board calling for the macadamizing and curbing of York St., Cottage Hill Ave. and Division St., 2 miles of streets. The ordinance will be adopted at the next meeting of the board, and work will be commenced at once. The estimated cost of the work is $30,000.—Aurora. It is likely that a large amount of paving will be done this season. Already 8 blocks have been provided for, and an additional mile is talked of.

***California.***—Sacramento. A basalt macadam pavement is to be laid as an experiment at a cost of 10 cts. per sq. ft.

***Utah.***—Salt Lake City. About 2½ miles of streets in the business district are to be paved, and brick will probably be used.

**Bonds.**—Alliance, O.; $33,000 for sewers and $20,000 for streets. Columbus, O.; $25,000 for streets. Marysville, O., $20,000 for streets. Missoula, Mont.; $65,000 7% for sewers, $25,000 7% for bridges; bids received until May 23 by H. S. Hoblitzell, City Clerk. Orange, Mass.; $25,000 4% for sewers; National Hide & Leather Bank, Boston. Passaic Co., N. J.; $40,000 for roads. Paulding, O.; $50,000 for streets. Waltham, Mass.: $150,000 for sewers. Denison, Tex., $145,000 for streets. Greeley, Col.; $10,000 for sewers. Newton, Mass.; $100,000 for sewers. West Grafton, Md.; for streets. Salem, N. C.; $50,000 for improvements.

## ELECTRICAL.

**Electric Light.**—New plants or extensions are reported as probable in the following places: Pomona, Cal.; Eureka Springs, Ark., address Dr. C. F. Ellis.; Key West, Fla., address Russell & Harvey; Westlake, La., address A. J. Perkins; Graniteville, S. C., address the Cotton Shoals Electric Light & Power Co.; Grovania, Ga., address the Grovania Oil & Fertilizer Co.; Macon, Ga., address A. M. Rodgers; Round Bay, Md., address J. H. Irvin, of Baltimore; Yreka, Cal.; Prescott, Ark.

***Beverly, Mass.***—The town has contracted with a local company for 82 lights of 1,200 c. p. burning until midnight at 30 cts. per lamp a night.

***Wheeling, W. Va.***—The Electric Light Commission appointed by the City Council has recommended the purchase of a plant at a cost not exceeding $100,000.

**New Companies.**—The Peninsular Electric Light & Power Co., Newport News, Va.; capital stock, $40,000; W. W. Archibald, Secretary. Consolidated Electric Co., Birmingham, Ala.; capital stock, $500,000. Maxstaadt Electric Co., Chicago, Ill.; capital stock, $100,000; incorporators, F. W. Maxstaadt, C. S. Cleaver, W. L. Marston. Cincinnati Electrical Supply Co., Cincinnati, O.; capital stock, $100,000. Harvey Electric, Water & Gas Co., Harvey, Ill.; capital stock, $100,000; incorporators, H. Badger, C. D. Starwood, W. G. Wanzer. People's Electric Light, Heat, Power & Street R. R. Co., Chicago, Ill., capital stock, $80,000; incorporators, C. L. Sackett, J. T. Ranney, G. K. Jones. Wataska, Ill., Electric Light Co; capital stock, $3,000. Dundee, Ill., Electric Light Co.; capital stock, $10,000.

## CONTRACTING.

**Street Signs.**—***Buffalo, N. Y.***—Proposals have been received by the City Engineer for (A) signs on houses, (B) signs on lamp posts, (C) signs and special post.

| | A. | B. | C. |
|---|---|---|---|
| William Carter | $1.50 | $4.00 | $9.00 |
| F. K. Plumbly | 1.30 | 1.40 | 4.48 |
| C. A. Lamphere | 1.45 | 1.85 | 7.85 |
| C. H. Hewitt | 1.75 | 2.30 | 6.60 |
| Frank J. Illig | 1.75 | 2.25 | 7.50 |
| T. J. O'Brian | 1.12½ | 2.25 | 8.25 |
| J. A. Jordan | 1.00 | 1.50 | 4.50 |
| Schwartz & Heutter | 1.75 | 2.25 | 9.00 |

Mr. Jordan also submitted a bid offering to place cast iron signs reading four ways on all street corners and to furnish a 3-in. wrought iron post where there are no lamp

posts for a lump sum of $11.90, and also to insure the signs against ordinary accident for 10 years.

**Highways.**—Proposals for the construction of 25 miles of wagon roads in the Yellowstone National Park were opened April 25 by Major W. A. Jones, U. S. Engineer Office, St. Paul, Minn. The clearing will be 30 ft. wide, the roadway 18 ft. wide and 6 ft. higher at the middle than the edges. On each side a berme of 1 ft., with a ditch on the outer side 5 ft. wide at top, 2 ft. at bottom, and 18 ins. deep. The road will be covered with 9 ins. of clay or earth. The bidders and the totals of their bids were as follows: *A;* W. A. Campbell, Dodge Center, Minn., $109,542. *B;* H. F. Balch, Minneapolis, and H. E. Stevens, St. Paul, Minn., $87,782. *C;* Geo. Parker & Co., Hastings, Minn., $71,251. *D;* A. L. Love, Livingston, Mont., $67,865. *E;* W. T. Preston, St. Paul, Minn., $70,982. *F;* Smith & Bradbury, Kansas City, Mo., $137,667. *G;* S. J. Truax and George J. Hetherington, Hastings, Minn., $75,037 *H;* Wyatt & Scott, Gardiner, Mont., $20,343, for Section 8 only. *I;* Wm. Z. Partello, Washington, D. C., $63,233.

| | *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* |
|---|---|---|---|---|---|---|---|---|---|
| Section No. 1. | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| Earth excav. 37,805 cu. yd. | .30 | .40 | .29 | .28 | .29 | .65 | .28 | ..... | .22 |
| Rock excav ... ..... | 4.50 | 2.00 | 1.60 | 1 49 | 2.50 | 2.00 | 1.00 | ..... | 3.75 |
| Loose rock excav..... | 2.50 | 1.00 | .75 | .53 | 1.00 | 1.00 | 2.00 | ..... | 1.05 |
| Retaining wall ..... | 10.00 | 4.00 | 4.00 | 4.57 | 5.00 | 5 00 | 5.00 | ..... | 6 00 |
| Riprap, 500 cu. yds..... | 8.00 | 2.50 | 1.75 | 1.97 | 2.25 | 3.50 | 2.00 | ..... | 2.00 |
| Grubbing and clearing 13.6 acres ..... | 200.00 | 75.00 | 115.00 | 39.50 | 30.00 | 150.00 | 100.00 | ..... | 27.00 |
| Total..... | 18,061 | 17,392 | 13,402 | 12,107 | 12,496 | 28,363 | 12,945 | ..... | 9,684 |
| Section No. 2. | | | | | | | | | |
| Earth excav. 27,770 cu.yd. | .30 | .40 | .29 | .28 | .29 | .65 | .28 | ..... | .22 |
| Rock " ..... | 4.50 | 2.00 | 1.60 | 1.47 | 2.50 | 2.00 | 1.00 | ..... | 3.75 |
| Loose rock excav..... | 2.50 | 1.00 | .75 | .53 | 1.00 | 1.00 | 1.50 | ..... | 1.05 |
| Retaining wall..... | 10.00 | 4.00 | 4.00 | 4.57 | 5.00 | 5.00 | 3.00 | ..... | 6.00 |
| Rip rap, 350 cu. yds..... | 8.00 | 2.50 | 1.75 | 1.97 | 2.25 | 3.50 | 2.00 | ..... | 2.00 |
| Grub. and clear. 17.2 acres. | 200 00 | 75.00 | 115.00 | 39.50 | 30.00 | 150.00 | 100.00 | ..... | 27.00 |
| Total..... ... | 14,571 | 13,273 | 10,643 | 9,144 | 9,356 | 21,855 | 10,195 | ..... | 7,273 |
| Section No. 3. | | | | | | | | | |
| Earth excav., 42,140 cu. yd. | .30 | .40 | .29 | .28 | .29 | .65 | .30 | ..... | .22 |
| Rock " ..... ... | 4.50 | 2.00 | 1.60 | 1.47 | 2.50 | 2.00 | 1.00 | ..... | 3.75 |
| Loose rock excav..... | 2.50 | 1.00 | .75 | .57 | 1.00 | 1.00 | 1.50 | ..... | 1.05 |
| Retain. wall..... | 10.00 | 4.00 | 4.00 | 4.53 | 5.00 | 5.00 | 4.00 | ..... | 6.00 |
| Riprap..... | 8.00 | 2.50 | 1.75 | 1 97 | 2.25 | 3.50 | 1.00 | ..... | 2.00 |
| Grub. and clear. 16 acres. | 200.00 | 75.00 | 115.00 | 39.25 | 30.00 | 150.00 | 100.00 | ..... | 27.00 |
| Total..... ..... | 15,842 | 18,056 | 14,063 | 12,427 | 12,700 | 29,791 | 14.242 | ..... | 9,702 |
| Section No. 4. | | | | | | | | | |
| Earth excav., 47,175 cu. yds. | .35 | .40 | .29 | .29 | .29 | .65 | .32½ | 25 | .22 |
| Rock " 200 " | 4.50 | 9.00 | 1.60 | 1 49 | 2.50 | 2.00 | 1.50 | 2.00 | 3.75 |
| Loose rock excav..... | 2.50 | 1.00 | .75 | .59 | 1.00 | 1.00 | 1.50 | .80 | 1.05 |
| Retain. wall, 3,850 cu. yds. | 10.00 | 4.00 | 4.00 | 4.51 | 5.00 | 5.00 | 5.00 | 2.00 | 6.00 |
| Riprap, 100 " | 8.00 | 2.50 | 1.75 | 1.98 | 2.25 | 3.50 | 1.00 | 2.00 | 2.00 |
| Grub. and clear. 3 acres.. | 200.00 | 75.00 | 115.00 | 39.15 | 30.00 | 150.00 | 75.00 | 250.00 | 27.00 |
| Total..... | 55,611 | 34,345 | 29,340 | 31,077 | 53,165 | 49,813 | 34,556 | 20,343 | 34,069 |
| Section No 5. | | | | | | | | | |
| Earth excav., 10,590 cu. yds. | .30 | .40 | .29 | .27 | .29 | .65 | .25 | ..... | .22 |
| Rock " ..... | 4.50 | 2.00 | 1.60 | 1.49 | 2.50 | 2.00 | 1.00 | ..... | 3.75 |
| Loose rock excav..... ... | 2 50 | 1.00 | .75 | .57 | 1.00 | 1.00 | 1.50 | ..... | 1.05 |
| Retain. wall..... | 10.00 | 4.00 | 4.00 | 4.55 | 5.00 | 5.00 | 5.00 | ..... | 6.00 |
| Riprap..... | 8.00 | 2.50 | 1.75 | 1.97 | 2.25 | 3.50 | 3.00 | ..... | 2.00 |
| Grub. and clear. 6.4 acres. | 200.00 | 75.00 | 115.00 | 39.00 | 30.00 | 150.00 | 75.00 | ..... | 27.00 |
| Total..... | 4,457 | 4,716 | 3,807 | 3,108 | 3,263 | 7,813 | 3,127 | ..... | 2,502 |

**Brush, Piles and Sand.**—The contract for improvement work at Laird's Slough has been awarded by Major W. H. Heuer, U. S. Engineer Office, San Francisco, Cal., to Charles A. Bigelow, of San Francisco: piles, 26 cts. per ft.; driving and capping piles, $9.20 per pile; brush in place, 70 cts. per cu. yd.; sacks and boxes filled with sand in place, 23 cts. per sack and $3.60 per box.

**Sewers.**—*St. Louis, Mo.*—Contracts have been awarded as follows by Mr. R. E McMath, Sewer Commissioner: *A* and *D*, Heman Construction, $38,916 and $3,412; *B*, Robert Sheehan, $1,117; *C*, John Hussey, $1,656.

| | $ | $ | $ | $ |
|---|---|---|---|---|
| Earth excav..... | .25 | .25 | .30 | .20 |
| Rock excav..... | 3 00 | ... | 3.00 | ... |
| Rubble masonry..... | 1.00 | ... | ... | ... |
| Brick masonry..... | 6 90 | 6 90 | 7.50 | 6.75 |
| 6-in. pipe sewers..... | .25 | ... | ... | ... |
| 12-in. " " ..... | .60 | .68 | .65 | .55 |
| 15-in. " " ..... | .75 | .78 | .80 | .85 |
| 18-in. " " ..... | .90 | ... | 1.15 | ... |
| 21-in. " " ..... | 1.50 | ... | ... | ... |
| 6-in. junctions..... | .30 | .50 | .55 | .40 |
| 12-in " ..... | 1.00 | 1 90 | ... | 1.00 |
| Inlet stone ..... | .60 | .55 | .65 | .60 |
| Cast iron..... | .02½ | .03 | .02½ | .02 |
| Wrought iron..... | .01 | .05 | .05 | .04 |

**Brick, Iron and Cement.**—*West Newton, Mass.*—The following proposals have been received by Mr. A. F. Noyes, City Engineer, for sewer material. For 1,500,000 sewer brick: Lindley, Wight & Co., East Brookfield, $8.40 per 1,000 for one-third arch and two-thirds body brick, or $8.90 for all body brick; Parry Bro. & Glidden, Boston, $9.95; M. W. Lands, North Cambridge, $10.50.—For 600 cast iron manhole frames and covers, 410 lbs.: Osgood & Hart, Charleston, $6.95 per set; Mechanics' Iron Foundry, Boston, $7.25; Bradley, Hastings & Co., $7.77; Union Iron Works, Lynn, $7.87½; Waltham Foundry Co., Waltham, $8.50; I. S. Cassin & Co., Philadelphia, Pa., $8.70; Edward Grenelle, New Bedford, $8.49; Wm. H. Carberry, Boston, $9.23.—For 5,000 bbls. American hydraulic cement: Smith & Green, Worcester, $1.08 per bbl. for New York Cement Co.'s; Waldo Bros., Boston, $1.14½ for Hoffman; E. C. Huxley, Boston, $1.10 for Obelisk, Akron; W. S. Nash, Boston, $1.20 or $1.25 for Hudson River Cement Co. or New York & Rosendale Co.; Howard Fleming, New York, $1.29.—For 250 bbls. of Portland cement: W. G. Nash, Boston, $2.45 or $2.50 per bbl. for Albion or Booth brands; Waldo Bro., Boston, $2.49, $2.53 or $2.63 for Port London wedge, Cleopatra or Brooks & Shoobred; Howard Fleming, New York, $2.64.

**Street Work.**—*Philadelphia, Pa.*—Proposals for 75,000 yds. of sheet asphalt pavement on a broken stone vulcanite base and binder, have been received by Mr. Windrim, Director of Public Works: Vulcanite Paving Co., $2.20 per sq. yd.; Geo. Knoche, $2.50; Philadelphia Paving & Construction Co., $3.25 on a hydraulic cement concrete foundation.

*Rockland, Me.*—Mr. O. H. Tripp, City Engineer, has received bids for street work and materials: Sullivan Granite Co., 92 and 55 cts. per ft. for 8 and 6-in. curb, 57 cts. per ft. for crosswalk stone, $1.40 per yd. for paving. Waldoboro Granite Co., 88 and 55 cts., 40 cts, $1.25, $1 per ft. for roundings for street corners.

*Roanoke, Va.*—The contract for sewer material has been awarded to Montague & Co., of Chattanooga, Tenn.: 8, 12 and 18 in. pipe, 20, 35 and 68 cts. per ft.; 8, 12 and 18 in. branches, 85 cts., $1.50 and $3.06 each; 12 and 18 in. bends.

**Water-Works**—*Aberdeen, Wash.*—Plans and specifications on file. J. H. White, City Clerk. May 13.

**Masonry, Etc.**—*Washington, D. C.*—Fishways at the Great Falls of the Potomac; excavation of rock and boulders, stone and concrete masonry and timber work. Lieut. Col. Geo. H. Elliott, Washington Aqueduct Office June 1.

**Embankment.**—Extending Great Miami embankment 34 000 cu. yds. Lieut. Col. Wm. E. Merrill, U. S. Engineer Office, Cincinnati, Ohio. June 1.

**Iron and Timber**—*Brooklyn, N. Y.*—Steel and iron work for bridge extensions, and 872,000 ft. B. M. of lumber. C. C. Martin, Chief Engineer, New York and Brooklyn Bridge, 179 Washington St. May 11.

**Street Work**—*Vincennes, Ind.*—Stone culverts and crossings. Geo. R. Green, City Clerk. May 12.

**Bridge.**—*East Greenbush, N. Y.*—Stone bridge, according to the plans and specification on file. David Newkirk, Highway Commissioner, Couse, N. Y. May 16.

## MANUFACTURING AND TECHNICAL.

**Locomotives.**—The Canadian Locomotive Works, of Kingston, Ont., are building 10 mogul engines for the Grand Trunk. A 25-ton passenger engine has been built at the Argenta, Ark., shops of the St. Louis, Arkansas & Texas. A new engine has been purchased by the Tunnelton, Kingwood & Fairchance. Ten fast freight engines are being built at the Mt. Clare shops of the Baltimore & Ohio. The Grant Locomotive Works, of Chicago, Ill., have invited architects to figure on the design of the buildings. They will include a machine shop, 140 × 370 ft.; erecting shop, 80 × 285 ft.; hammer shop, 80 × 125 ft.; blacksmith shop, 80 × 250 ft.; paint shop, 70 × 160 ft.; boiler shop, 100 × 250 ft.; wood-working shop, 70 × 220 ft.; pattern shop, 60 × 130 ft.; foundry, 89 × 200 ft.; dynamo room, 50 × 60 ft.; core room, 50 × 60 ft.; cupola room, 60 × 80 ft.; boiler room, 50 × 70 ft.; office and store, 40 × 130 ft.; President, E. T. Jeffrey; capital stock, $800,000.

**Cars.**—The Pullman Palace Car Co., of Chicago, Ill., has built 20 cars for the Brooklyn Elevated; they are fitted with Baker heaters. The Laconia Car Co., of Laconia, N. H., has an order from the Boston & Maine.

**Car Lighting.**—The Baltimore & Ohio is applying the Pintsch system to the postal cars running between New York and Washington. The New York, Lake Erie & Western was the first to apply it to postal cars, and the Chesapeake & Ohio, Richmond & Danville and other roads are now applying the system to postal cars.

**Car Couplers.**—The Hinson Car Coupler Co., of Chicago, Ill., has contracts for equipping with its M. C B. automatic couplers 850 cars for the East Tennessee, Virginia & Georgia and 500 for the Louisville Southern.

**Pipe Joint Grease.**—The Joseph Dixon Crucible Co.'s pipe-joint grease is said to be excellent for the mud plugs of locomotive boilers.

**Smelting Works.**—Extensive works are to be established near Buffalo, N. Y., by the Buffalo Smelting Works. W. R. Haven has the contract.

**Hoist.**—The John F. Byers Machine Co., of Ravenna, O., has placed on the market a double drum hoist, with boom drum independent of main drum, except when being used.

**The Drexel Car Coupler Co.**, of Chicago, Ill., has opened offices in the Rookery Building. President, W. A. Alexander; Vice-President, A. C. McCord; Treasurer, M. A. Kilvert; Secretary, D. W. McCord; General Agent, H. Nource.

**The National Surface Guard Co.**, of Chicago, Ill., has moved into new offices in the Rookery Building. It is said that over 12,000 of these guards are in use on 160 railways, and several orders have recently been received. Mr. J. T. Hall is manager.

**The Nye Steam Vacuum Pump Co.**, of Chicago, Ill., is putting in new engines. Two pumps for pumping and washing white sand, capacity 40 tons per hour each, are being constructed for Hoxey & Arngen, Serena, Ill.

**The Shaw Electric Crane Co.**, of Milwaukee, Wis., will remove its works to Muskegon, Mich. Plans for a machine shop 100 × 200 ft., and power house, etc., have been prepared by Mr. T. Appleton, of Chicago.

**The Western Paving & Supply Co.**, of Chicago, Ill., has removed to a new office in the Northern Building, La Salle St.

**Companies.**—Perfection Car Co., Jersey City, N. J.; W. J. Watson and Wm. McArthur, of New York; Wm. F. Chittenden, of Brooklyn, N. Y.; $100,000. Wasatch Asphaltum Co., of Salt Lake City, Utah; President, G. F. Calmer; Superintendent, S. V. Sieur; $125,000. National Industrial Co. of Honduras, Chicago, Ill.; D. B. Hubbard and D. L. Perry; $200,000. Hunter Steel Co., of Chicago, Ill.; M. S. and E. I. Frost and J. C. Poller; $500,000. International Railway Supply & Improvement Co., of Chicago; Geo. C. Gardner, J. Rielman and J. N. Norton; $1,500,000. Youngstown Metal Lath Co., of Youngstown, O.; Lloyd Booth, Geo. A. Baker and W. G. Huribut; $100,000. Great Western Canal Construction Co., of Chicago, Ill.; S. L. Baker, J. P. Mallette and M. F. Holmes; $160,000. Cable Iron Car Roofing Co., of East Louis, Mo.; R. Northrup, J. C. Wands and G. A. Banantine; $300,000.

**Metal Market Prices.**—*Rails.*—New York: $30.75; old rails, $24.50 for iron and $17 for steel. Pittsburg: $30; old rails, $24 for iron and $17.75 for steel. Chicago: $31; old rails, $22.50 for iron and $15 to $17 for steel.

*Track Materials.*—New York: steel angle bars, 1.7 to 1.75 cts.; spikes, $1.9 to $1.95; track bolts, 2.65 cts. with square, and 2.75 cts. with hexagon nuts. Pittsburg: splice bars, 1.85 to 1.95 cts. for iron or steel; iron or steel spikes, 2.05 cts.; iron track bolts, 2.85 cts. with square, and 2.9 cts. with hexagon nuts. Chicago: splice bars, 1.85 to 1.9 cts. for iron, 2 to 2.05 for steel; spikes, 2 cts.; track bolts, 2.8 to 2.9 cts. with hexagon nuts.

*Foundry Pig Iron.*—New York: $14 to $16. Pittsburg: $14 to $16. Chicago: $14.75 to $16.

*Pipe.*—Cast iron, $25 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 55 and 45 per cent. on black and galvanized butt-welded; 65 and 52½ on black and galvanized lap-welded. Casing, 55 per cent.

*Lead.*—New York: 4.25 cts.; Chicago: 4 to 4.1 cts.; St Louis: 4 to 4.05 cts.

*Structural Material.*—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.95 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 2 to 2.25 cts.; steel plates, 2 to 2.15 cts. for tank, 2.3 to 2.6 cts. for shell, 2.5 to 2.7 cts. for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2.05 cts.; tees, 2.65 cts.; universal iron mill plates, 2.1 cts.; sheared steel bridge plates, 2.3 cts.; refined bars, 1.85 to 1.9 cts.; steel plates 2.1 to 2.15 cts. for tank, 2.45 to 2.5 cts. for shell, 2.7 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.25 to 2.3 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.3 to 2.4 cts.; sheared plates, 2.5 to 2.6 cts. for iron and 2.6 to 2.7 cts. for steel; steel plates, 2.6 to 2.7 cts. for tank, 3.25 cts. for shell, 3.5 cts. for flange, 4.25 to 5.5 cts. for firebox; boiler rivets, 4 to 4.25 cts.